AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

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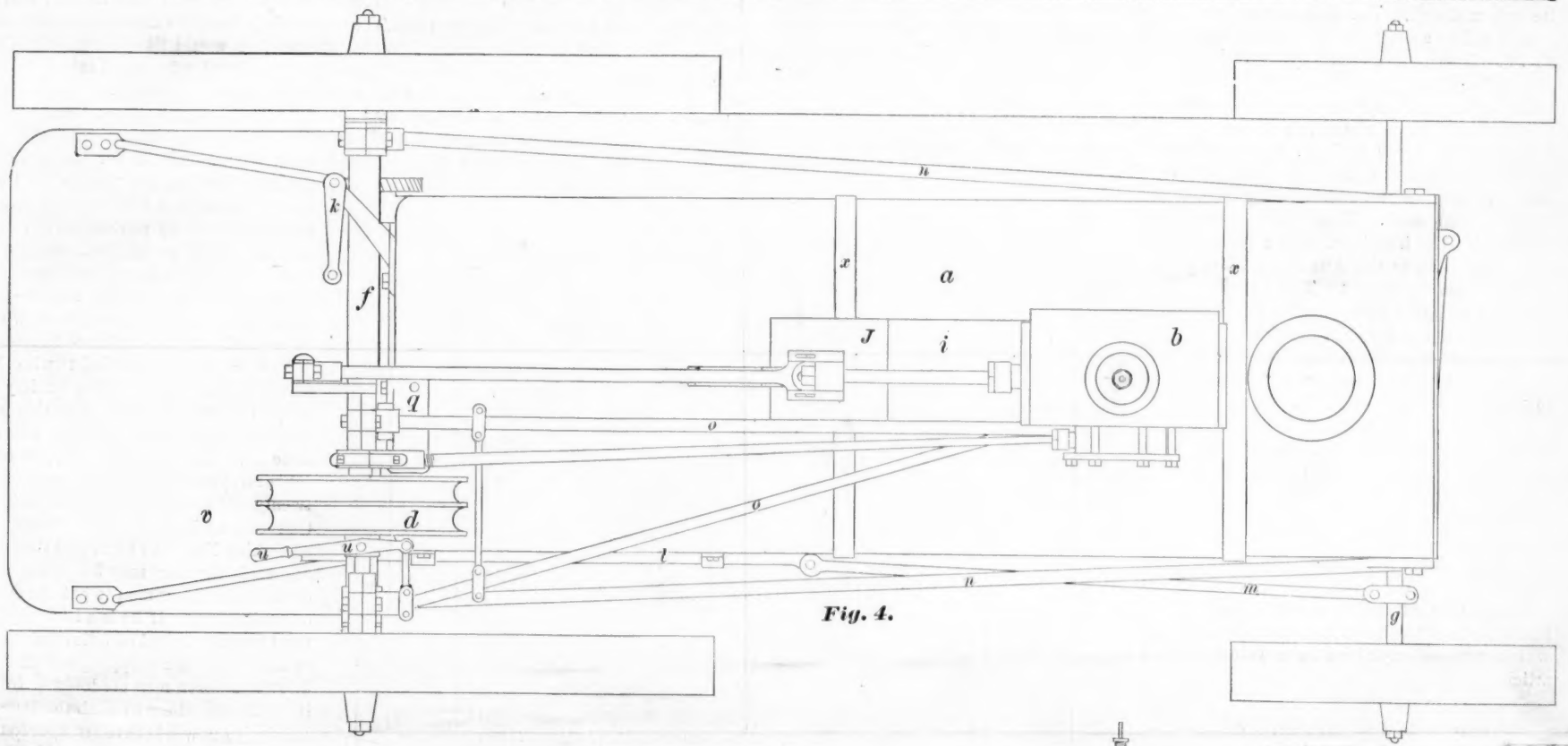


Fig. 4.

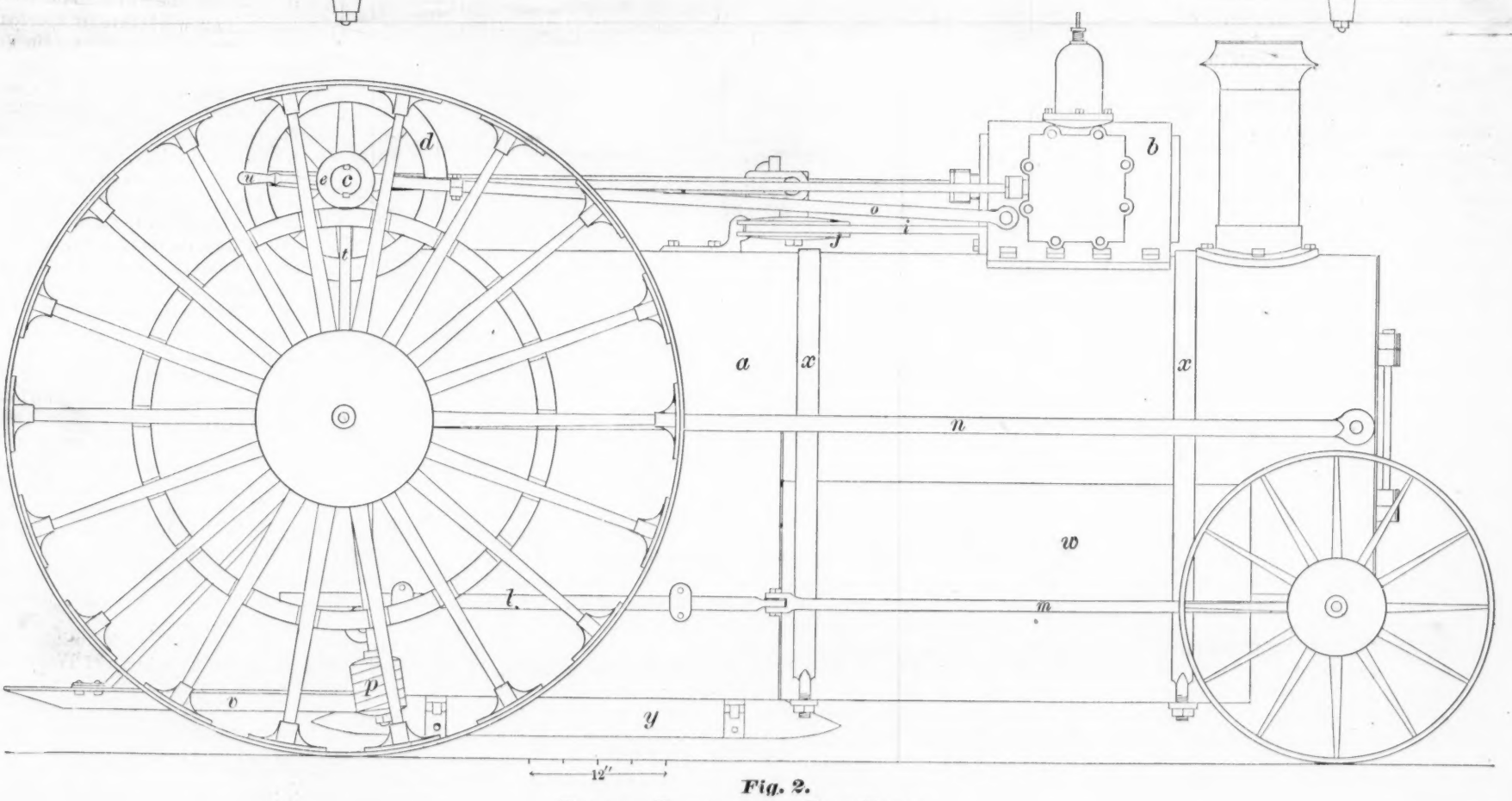


Fig. 2.

PLAN AND ELEVATION OF A FARM ENGINE.

A Simple Farm Engine.

BY F. G. WOODWARD.

The wide-spread interest which attaches to the application of steam power to farm work, induces me to offer a novelty in that line. The plan here presented was made at the suggestion of a gentleman from the West, who wished me to draw up what I conceived to be the best arrangement for a portable engine for farm work, both as self-propeller, and as a stationary engine.

My first idea was to use two cylinders, but on looking over the history of this branch of steam engineering, I found that a single cylinder had proved to be all-sufficient for every emergency.

One of the chief novelties of this engine is the method of connecting its active parts with the boiler, so as to secure the full benefit of the springs, and not impair the efficiency of the engine.

By referring to Fig. 2 and Fig. 4, it will be observed, that the engine rests upon three spiral springs, two of which take the weight of the furnace end of the machine, shown at *P*, while the one which takes the weight of the front end is placed in a socket at the centre of the guiding axle *g*.

The method of attachment is clearly shown. A stiff bar *h*, Figs. 1 and 3 (pages 2 and 3), is bolted to the mud ring of the fire-box, having an eye in each end for the reception of the suspension rods *s*, the springs *p* being connected to their lower end, and the upper end being jointed to the main axle *f*, as shown. The crank shaft *c*, is jointed in like manner to the main axle by the rods *t*. The main axle is held to its working position by the braces *n*, and the guide-block *z*. This block is bolted to the boiler, and has a vertical slot for the reception of a slide (not seen) fixed to the axle. The crank shaft *c*, is held to its working position by the braces *o*, and the standard *Q*, the standard being bolted to the boiler, as shown, and having a vertical fork at its upper end for the reception of a projection on the box of the crank shaft. It will be seen that this arrangement holds the running gear firmly to its working position, and at the same time permits the free action of the springs. The

tension of the springs is such that their maximum vibration shall not exceed one inch. The fly-wheel is grooved for two round belts This belt does not require so exact an adjustment of driver and driven pulleys as the flat belt does, hence it is better adapted to the ever-changing locations and conditions of farm work. The traction pinion *e*, may be slid out of gear, as indicated by the dotted lines in Fig. 1, when not in use. The cylinder *b*, is cast double to serve as a steam dome, and is surmounted by a safety-valve, as shown, inclosed in a case, the escaping steam being conducted to the water tank. A single plate guide *i*, is bolted to the cylinder at one end, and is held in a jaw at the opposite end, as shown. The slide or crosshead *j*, is adjusted by a single screw beneath, seen in Fig. 2. Steering is effected by a "rack-and-pinion," and "worm-and-gear arrangement;" *l* the rack; *m* the rod, connecting rack to guiding axle *q*, as shown; *k*, the steering handle. The water tank *w*, is suspended beneath the boiler *a*, by two iron straps *x*. There is ample room on the foot plate *v* for the coal bunk. The reversing is effected by the handle *u*, on the principle illustrated in the American Machinist, Jan. 3d, page 4. The handle *u*, works a sliding collar on the crank shaft *c*, the collar being connected to a steel pin which slides through the hub of the fly-wheel, and holds the eccentric to its working position. It will be noticed that the main axle *f*, is placed about even with the center of the boiler (as to its height), which brings the center of gravity of the engine low, which is an important feature in this class of engine; the bottom of the ash-pan being about five inches from the ground.

There are other details about the internal make of the boiler, cylinder, &c., which will be explained in a future article.

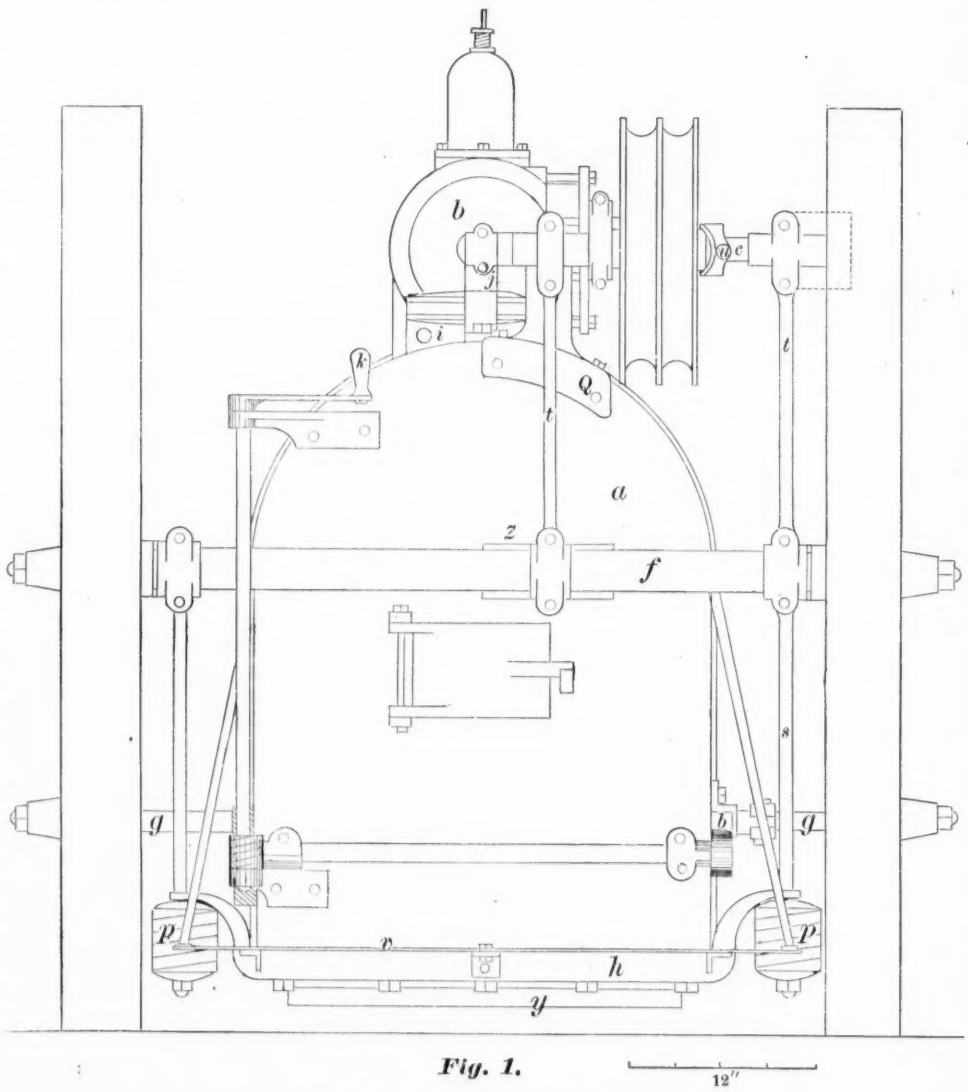


Fig. 1.

Back Outline View of Farm Engine.

Copper in New Mexico.

The copper mines of New Mexico are attracting more attention daily. One of the richest deposits is at Clifton, some 93 miles west of Silver City. The ore is apparently unlimited in quantity—being in fact a solid mountain of copper. Though fuel has to be carted 35 miles at a cost of $40 a ton, and the copper when smelted has to be carted at a cost of $70 per ton to the nearest railroad station, the business is carried on at a large profit. At Santa Rita, near Silver City, are extensive copper deposits, which have been worked over 100 years. There are many other extensive and rich deposits of native copper.

Extracts from Chordal's Letters.

Mr. Editor:

* * * * One might suppose that a proprietor of a machine shop did not need to care what his employees do with their wages. But he does need to care, and does care. From a long association with owners and workmen, I am led to believe that most proprietors give more care and thought to the comfort and well being of their men than the men do themselves. The proprietors may not express themselves on the subject because they know such expression would generally be useless; but, with a keen eye for policy, they see that if workmen at the end of a year say to themselves, "Our employer has got more money than he had at the commencement of the year, while we who did the hard work have not a dollar to show," there is but little stimulus in the thought; and a coming year is not very apt to bring out any extraordinary endeavors to excel in execution. At the same time they see that the exceptional workman who can claim to be the possessor of two or three thousand dollars, is a man to be depended on. Such a man seems to understand that he is independent, and that this independence is the result of prudence and judgment and forethought, and, as a matter of course, he seeks to render his condition still better by a further development of those qualities—qualities, by the way, which every smart employer sees are to his interest. This independent man asserts his independence every moment of his life by actions noble and estimable, while his co-laborer, without a dollar in his pocket, seeks to palm off a devil-may-care heedlessness as real independence. The don't-care-man is never independent in any situation in life. It is the exercise of care which makes men independent.

* * * * The thoughtful proprietor takes a machinist to some private corner and talks to him confidentially. Tells him he has paid him over ten thousand dollars in wages, and asks him how much he has saved up. The man answers, "not a red." Owner advises him to do something better, to contrive some plan for saving, &c. Man says he is not a contriving financier but a machinist who never could save a cent. Tried it lots of times, but never saw two hundred dollars of his own money in his life, and never had anything to show for what he had spent; says money won't stay about his clothes. Mr. Proprietor tells Mr. Man that money won't stay about anybody's clothes. Says he couldn't pay off his men if he tried to carry the pay-money in his breeches a week.

* * * * The proprietor determines to experiment with this fellow. He pays him in bank checks and advises him to open a bank account. The man has always associated pay night as a time with lots of money in his pocket—not to spend, but to look at and have—and he carries his bank account one consecutive month, and then gets his checks cashed at a corner grocery and goes on as before. The owner sees this is a failure, and offers full interest on balances left in the office. The man has always associated pay night with money to look at, &c., &c., and he manages to keep up the habit of drawing only six dollars a week for about two weeks and then quits it. Owner advises man to buy a lot and, by running into a debt which he can easily pay, finally have something for his hard work in the shop. The man buys imprudently and sinks about a hundred dollars in the real estate, when friends tell him he has already paid too much for the lot; so he quits it. He loses a hundred dollars, but don't need any of our sympathies, for money is nothing to this man. Next a mutual benefit association is formed in the shop. Men who can't save their own money are made financial agents for a lot of men just like themselves. The men get such an idea, anyhow, and, thinking their money not safe, they forget that a journeyman machinist's money isn't safe anywhere within his reach, so they draw it out to put somewhere else. They never put it, however, and soon things go on as usual—not ten dollars left the day before pay night.

* * * * The more our shop owner tries to invent plans to help his men into comfort the more he fails. The men won't have it. They don't work for money, you know; they work because they like to work hard. But let some poor devil of a machinist who has a house and lot, and a bank account, and home comforts, and no debts, dare to work when the hundred thousand want a dime a day stuck on their pay, and there will be fun.

The motto of the hundred thousand machinists I speak of, is: "Live and let live," and this motto they howl continually when there is a grievance they can kick up a row about, but I notice that these very chappies won't live and won't let others live.

* * * * If there is anything I abominate it is one of this kind of machinists. You will find a sample or so in every shop. He tries to swagger himself into an air of independence. He talks of some workmen as ruining the trade when he himself is the very man who does the wholesale ruining. He too often forms the base of values, and his betters have to suffer accordingly. He will accuse some men of working for nothing a day, when he himself has been working for nothing his whole life. Money is wasted on such a man.

* * * * When the ten dollar refunding certificates came out last year it was thought they would be a good thing for the workingmen. For the hundred thousand they were too good a thing, and were quickly gobbled up by men wiser than this class.

* * * * The question of interest on investment need not enter in the calculation of the hundred thousand. The principal is what they want to see. They want something to put their money into, something safe and sure and compulsory, and of the form of money after it is in. I give it as my honest opinion, Mr. Editor, that if Mr. Sherman would issue some *four per cent. discount bonds* of the denomination of nine dollars, convertible in one year into real four per cents. or one per cents. even, he would be doing a good thing by our hundred thousand. The banks would'nt gobble these little bonds very much, and when the hundred thousand got some they would have to hold them a while; and besides that they seem like money, and so would satisfy the old cravings to take a look at the pay. I would like to see one of the hundred thousand who could take a look at a dollar he earned a year ago.

* * * * I really think, Mr. Editor, that the building associations offer the best and most adaptable field for the hundred thousand, and as the "points" of these useful institutions are generally totally misunderstood by workingmen, I may say something about them some day. You may preach about prudence and thrift, when the real problem is—prudence and thrift being absent—how can their results be accomplished?

* * * * A machinist who has traveled and worked in a variety of shops is always a more valuable and desirable man than one who has not done so. If a man comes to you for a job, and you find he has worked in twenty different shops, you feel satisfied that one at least of these shops was something like your own, and that consequently the man may fit. How long does it take a new man to get the swing of a new shop? If he is a little shy, he must pass the ordeal of fellow criticism. When he grabs a chipping hammer, he knows a dozen men are looking to see if he knows where to grab the handle. He don't know whom to trust, or to talk to, or to ask questions of. He don't know how your work is done, or whether you look to time or quality, or whether you sympathize with or blame one who errs. He don't know where to find things, and he don't know what things there are to find. He feels like a cat in a strange garret, and it takes things a long time to get smoothed up. When they do smooth up, this man's value begins to count. If you and he had had years of shop association, would he not be worth more to you than he would to any other shop? If he is good for anything, you know what he is good for. If he is good for nothing, what did you associate with him so many years for?

* * * * If Tubal owns a machine-shop, and graduates an apprentice at the end of four years, and then offers that apprentice, say, a dollar and a quarter a day, and that apprentice goes to the very next town and gets, say, a dollar and seventy-five, what would you think? Would you say the policy was short-sighted on the part of Tubal? Would you say Tubal wanted the world to know, as if by a brand, that a workman of Tubal's manufacture was not worth much; or would you believe that Tubal was sordid enough to try to take an advantage of the semi-parental position he had occupied?

* * * * There are many shops in which it seems impossible for an apprentice to get justice after his time is out. The justice I refer to I gauge by the measurement of outside shops. I throw up my hat every time a young chap, who has served a faithful term of apprenticeship, skips from under a shop which wants to own him too cheaply.

I am glad, because it gets the boys whatever pay the world will give them, and it makes them travel, and travel makes them wiser.

* * * *

Very respectfully,

Chordal.

Practical Draughting—How to Mount Paper.

BY T. P. PEMBERTON.

Drawing paper can be fastened to a board either by means of "thumb tacks," as represented, Fig. 7, or by dampening the sheet, and while it is moist gumming the edges to the board. This is termed "mounting" the sheet, and as to do it well requires some knack, and as it is an operation in which students frequently fail, a minute explanation of what to do and how to do it is here given.

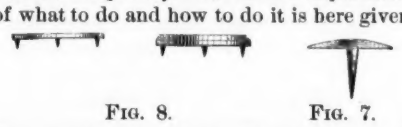


FIG. 8. FIG. 7.

One word, first, about thumb-tacks. In selecting them get those in which the steel point is *screwed*, not riveted into the head. The head should be convex and thin, so that the blade of the T square will slide over it without striking and notching its edge. Thumb-tacks with raised edge are very objectionable on account of the blade of the square coming into contact or striking against them. Horn centers, Fig. 8, are useful where a number of arcs or circles are to be drawn from one center; they prevent large unseemly holes in the paper. In place of a horn center, a small piece of card board gummed to the paper may be substituted, but horn is better.

When drawings for the work-shop are "wanted right away," as they generally are, or when a drawing will not require much time to make it, the paper may be held down by thumb-tacks, but when a drawing will occupy much time in execution, owing to alterations in design and minute details; and when tinting and shading in India ink and water-colors are to be applied, the sheet should always be mounted. The way to do this is as follows:—The drawing-board and T square being, of course, "true," and in good condition, the sheet of paper is first laid on the board *right side up*, its edges as near parallel with the board edges as possible. Take the T square and rule off half an inch from each edge: cut off with a sharp knife the strips ruled off. The object of doing this is to get rid of ragged edges, and to have the edges of the paper parallel with the edges of the drawing-board. It may not be always necessary to do this, but in every case, there should be no uneven edges, and it is best to have the edges of paper and board parallel with each other. Turn the paper over, and with a small fine sponge and clean water, dampen well the whole surface except half an inch or a little more at the sides, if the sheet is "Double Elephant" or larger than that size. See that every part of the sheet is well moistened except the edges or border, which are left dry to take the gum or glue. Now, with a mucilage brush well charged with strong mucilage, paint the dry edges. Go round these edges with the brush until it begins to feel sticky in the hand. Then taking the two upper corners of the sheet in the forefingers and thumbs, hold it up perpendicularly. Square the sheet with the board, and lay down the sheet, being careful not to let the gummed edges touch the board anywhere but just where it is to adhere.

With the thumb nail (*if it is quite clean*), or a smooth ivory handle rub down the edges until they stick evenly to the board without any over-laps or puckerings. The sheet will now appear raised and uneven and blistered. Leave it alone; don't touch it with the hands or anything else. It will soon be discovered that a dampened sheet of white paper is very sensitive to dirt or the slightest impress. Place the board flatwise (not edgewise), in a cool place to dry, and in a short time the paper will have contracted and dried, presenting a beautiful smooth surface, which is permanent. The success of this operation depends in a great measure upon the consistency of the mucilage. An ounce or two of gum arabic procured from any apothecary, completely dissolved by water in a mucilage or wide-mouthed bottle, gives an aqueous solution of gum stronger than ordinary mucilage. The object is to get strong, not thin gum,—gum that will *dry quickly* and *hold firmly*. Thin glue can be used, but as it dries quickly each edge of the paper must be folded down as soon as glued. With large sheets of roll paper glue is preferable to gum, on account of the great amount of contraction.

Paper is sensitive to the condition of the atmosphere. When it is pinned down, or even mounted, it will often show expansion, and in this case must be re-pinned or dried, so that the lines, if any are drawn, shall coincide with the blade of the T square as originally drawn.

The great desideratum in putting a sheet of paper on a drawing board is to have it smooth and even. Sometimes it will be found necessary to trim off the edges. Drawing paper procured in sheets, should be kept flat in a drawer and not rolled. Never roll a sheet of paper or a drawing when it can be preserved flat, and finger them as little as possible. Do not make a drawing board, when in use, a shelf to hold instruments, cabinet saucers, rule, &c. These, with other tools, should be placed at the right of the board, but not on it. Practice will soon convince the young draughtsman of the correctness of these instructions.

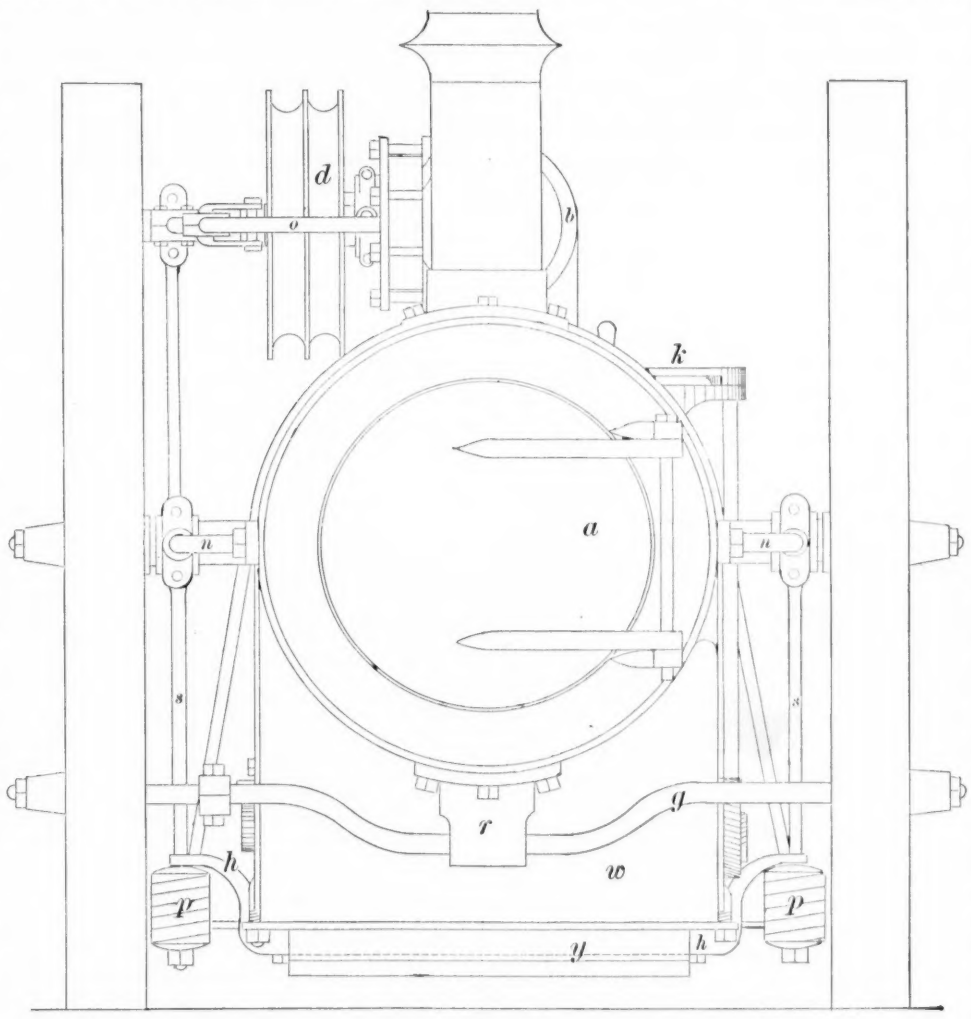


Fig. 3.

FRONT OUTLINE VIEW OF FARM ENGINE.

Velocity and Pressure of Wind—A Correction.

Editor American Machinist:

Your issue of Jan. 31 contains an article by Mr. Geo. S. Strong, entitled, "Wind as a Motive Power—Its Velocity, Duration, and Pressure," upon which I would like to offer a few brief comments.

I believe that the great number of windmills manufactured in the United States and now used in this, as well as in the newly developing countries—a matter of record and observation—contradicts Mr. Strong's statement that "due credit is not given this cheapest and most primitive of all modes of motion."

The table giving the relation between the velocity and pressure of wind, which he presents, is one originally communicated by Mr. Rouse to the English engineer, John Smeaton, in 1758, and since reprinted in almost all engineering text books and pocket books. A few years ago, while engaged in a discussion of the theory of the impulse of air upon a vane, I showed the aforesaid table to be inaccurate; for the reason that the pressure depends upon both the velocity and the density of the air, and that this density depends upon the *temperature, the barometric pressure, and the pressure due to the motion of the air;* so that a variation in temperature alone, from 0° F. to 100° F., produces a difference in the amount of pressure for a given velocity of wind of over one-fifth the total amount. Taking these data into consideration, I computed quite an elaborate table, which was verified by experiment, and which has since had quite a circulation in our technical journals.

By calling attention to these facts, I merely desire to point out how conservatism, faith in old authorities and lack of proper investigation, often lead us to err in accepting as correct and in reproducing what can readily be demonstrated to be wrong.

Very respectfully,

ALFRED R. WOLFF.

85 Astor House,
New York, Jan. 22, 1880.

It is stated that the predicted general advance in railroad-employees' wages will take place March 1st.

Cost of Locomotive Duty.

The New Jersey Central Railroad, which is in the hands of a receiver, keeps a record of the cost of running locomotives. It shows that an average day's distance traveled by a locomotive is 100 miles. The work for a month is 2,600 miles, but some locomotives exceed this, as in the case of No. 121, which in December made 6,080 miles. In doing this, 133 tons of coal were used and 37 gallons of oil to keep the machinery in order. The receiver says that $12.86 is the average cost for 100 miles for men, fuel and repairs. In the case of No. 121 the cost for repairs for the month was $22.58. A similar showing is made by the D. L. and W. R. R. We are permitted to give the following summary of their Nov. 1879 report.

Number of engines, 133.		
Passenger engines, miles run,		28,261
Freights,	" " "	40,787
Coal,	" " "	296,309
Miscellaneous,	" "	5,700
Total miles run,		371,057
Coal rated at $1.69 per ton.		
Average cost per mile for repairs,		$3.55
" " Engineers, firemen, and wipers,		5.12
" " Oil, waste, and tallow,		46
" " Fuel,		7.24
Total average cost per mile run,		$16.37

This is for the whole number (133) of engines. The average is therefore $12.31 for each engine per 100 miles for men, fuel, and repairs.

Average miles to 1 pint of oil,	23.06
" " 1 pound tallow,	32.29
" " 1 ton of coal,	23.34

The D. L. and W. R. R. is an unusually crooked road with steep and long grades.

We are acquainted with parties who state, on reliable authority, that an American road having 100 engines can be run at an expense of three cents per mile, each engine making 3,000 miles per month.

B. F. Spinney & Co. have advanced the pay of the workmen in the shoe factory at Norway, Me., ten per cent.

Sager, Ashworth & Co., file works, Lowell, Mass., increased the wages of their workmen 10 per cent., Jan. 1.

The Co-operative Furniture Company of Orange, Mass, have declared a dividend of 8 per cent.

A Big Diamond Drill.

A machinist of this city, says the *Virginia City* (*Nev.*) *Enterprise*, is engaged in figuring out a diamond drill which will cut a tunnel of ordinary size. Its main feature is a rim of saw-blade steel six feet in diameter and three and a half feet in width, with diamonds set in one edge. When a cut a yard in depth has been made the drill is run back and the block of rock knocked out. The machine is really a kind of circular saw. There is a sort of centre-bit, also armed with diamonds, that goes a little in advance of the main saw and makes a hole an inch and a half in diameter. This assists in giving a steadiness to the main tool, and leaves a hole in which to insert a giant powder cartridge and knock out the block of rock when a cut has been made to the proper depth. This novel drill is intended for use in hard rock only, though it may be used in soft rock where the ground is not too wet and heavy.

The exports of pig and scrap iron from Belgium in the first ten months of 1879, amounted to 17,411 tons, against 3,949 tons, and 9,915 tons, respectively, in the first ten months of 1878 and of 1877. The large increase of exports in the first period as compared with each of the last two is due to the American demand.

The Ironmonger says: Fancy bellows of the better class, with hand-ornamented surfaces and brass nozzles in the Queen Anne style, have been in improved request of late for boudoir and drawing rooms, but, where price is an object, the French and Swiss makers are rather formidable competitors.

ALUMINUM TELEGRAPH WIRES.—German telegraphic engineers have lately been experimenting with aluminum as a material for telegraph wires. This metal can easily be drawn out to a much finer gauge than is possible with iron, and its conductibility is twice as great as that of iron wire. Its excessive cost has hitherto prevented its use for the purpose indicated, but it is found that an alloy of aluminum and iron can be easily made, which will produce a wire both finer and stronger, and less susceptible to atmospheric changes than iron wire, while it is much superior as a conducting medium.

Masonry and Fittings of Steam Boilers.

BY F. B. ALLEN, M. E.

With an externally fired boiler of the cylindrical flue, or tubular type, properly designed and constructed, durability and economy, as well as safety, depend largely upon its setting. (The masonry surrounding a boiler is known technically as its setting). Where circumstances permit, the best location for a boiler is in a boiler house, apart from the other buildings. In our large cities ground space is so valuable that this cannot be done; and, to avoid placing it under the building (which is very dangerous), it is generally put in a vault under the sidewalk, or in the rear of the premises. When placed in a vault care should be taken to have it dry and light; and the boiler so placed that it may be accessible in every part for examination, cleaning and repairs. A mistake too often made is that of setting boilers in a dark and mouldy place where they are sure to be neglected. In this situation they speedily corrode, it being a fact long since established that corrosion is the most destructive and difficult malady with which boilers are attacked. The annual reports of the Hartford Steam Boiler Inspection and Insurance Co., show that a large percentage of defects in boilers they examine are due to this cause.

The following notes may seem to illustrate the mistakes of every day occurrence, and the necessity of consulting a constructing mechanical engineer when plans of building are made, thereby avoiding the trouble and expense of alterations afterwards.

A few years ago, to make an inspection of two boilers in a certain place, it was necessary to empty a fire-proof vault, that the architect had foolishly placed over the boilers forming part of their setting, and to break away enough of a heavy wall to admit the inspector, who found the space behind the bridge wall and underneath the boiler bottom filled with soot and ashes, leaving barely room for a draft. These boilers had been in operation about four years and, of course, had not been cleaned out during that time. They had been tested by municipal inspection annually, and certified as in good and fit condition. Many tons of coal would have been saved had a cleaning door been put in when these boilers were set.

Another illustration of "how not to do it" occurs to me in the case of four boilers set in a vault of one of our largest down town buildings, the top of dome being within eight inches of the flagging of sidewalk, access being had to these boilers through a man-hole in dome head. It was impossible to get inside of them until the heavy sidewalk flagging could be cut out and plates fitted in over the man-holes. In each of the cases noted, the architects had finished their work, and the municipal authorities had tested the boilers and given certificates. Had it not been necessary to make a thorough internal examination of the boilers for insurance purposes, these defects would in all probability not have been discovered until after an accident occurred.

Many tubular boilers are set so as to have the heat return over the top of the boiler, after having passed underneath and through the tubes. It is claimed that a very important saving of heat is obtained by this arrangement. On the other hand, many practical men of large experience deny that any saving can be effected in this way. They contend if the boiler is properly designed and set, all the available heat will be utilized in passing it under the shell, and returning it through the tubes to the front end, thence to chimney. The disadvantages of returning the heat over the top of boiler are: the top is not accessible for cleaning or repairs, cannot be properly examined and its certainty of being injured when fires are started with cold water in the boiler, as they are in most manufacturing establishments on Monday morning. At such times the heat acting on the exposed sheets on boiler top (they not being in contact with either water or steam) expands them unequally, and soon makes them brittle and weak. They begin leaking on girth seams and around the flange of the steam dome, checking and cracking, thus requiring patching and new sheets. Even if we admit a saving of heat by this plan of setting (returning over the top) its economy is very questionable, if it lessens the durability and increases the danger of explosion of the exposed sheets.

Ten years ago a patent form of boiler setting, which required placing it in an oven and allowing the heat and flame free play all around it, was introduced to some extent, a great saving of fuel and increased durability being the inducements offered. So far as known the saving was not sufficient to cause it to be retained, for the lap seams above water line soon began to leak, and some of the boilers ruptured dangerously in the shell, doing considerable damage and requiring extensive repairs.

Profiting by experience, and not unmindful of sundry recommendations rather forcibly made by "Boards of Inquiry," "Coroners' Juries," etc., on the many disastrous explosions of marine boilers under United States inspection, it is ordered that in future for marine boilers, boiler covering shall be put on in sections that can readily be removed to examine the boiler, its connections and attachments. Recent improvements (?) in stationary boilers seem to consist of arches over the top and close underneath the boiler bottom, with which it is impossible to get at the sheets to make a thorough examination or repairs when required.

Many boilers are injured by allowing the flame to act upon that part of the back head above water line, owing to the arch being built too high. It should be on a line with the upper row of tubes. This precaution having been disregarded by some masons, in cases coming under my notice, the arch had afterwards to be lowered. The main walls of the setting vary with size and weight of boiler, but should not be less than twelve to sixteen inches thick. Many masons leave a two-inch air space in each side wall. This permits the escape of any moisture, and lessens the danger of bulging or cracking the walls. All that part of the setting exposed to the flame should be faced with fire brick. In laying fire brick but a small quantity of clay should be used in joints and the bricks should be rubbed together to remove any surface irregularities. With heavy joints the bricks soon loosen, and the walls crack and fall. It will be found most economical to buy the best quality of fire brick, the increased cost being more than made up by its greater durability and the facility with which good joints can be made.

There are various ways of setting boilers practiced by those engaged in that business, and, where experienced masons can be employed, it will always pay to have them. In many places where boilers are to be set, such workmen cannot be had. A simple plan, under such circumstances, is to move the boiler to its place and block it up to the height required, which ought to be about 4½ feet from ground to give furnace 20 to 24 inches deep, and a roomy ash-pit. Some boilers of which I have knowledge have recently been set having 3½ feet from fire sheets to grate bars, and those using them consider it a great improvement over the old plan. We next level the boiler, if thought necessary (and many do). A slight pitch—say 1½ inches in boiler of 16 feet length—may be given towards back end; it will help drain bottom sheets in emptying the boiler, and, to a limited extent, save the upper row of tubes from burning, in case of moderate low water. With the boiler in place to guide us, we build walls enclosing it to a height of about 15 inches above its own top. This space may afterwards be filled in with some light non-conducting material. Be careful to put a cleaning door in side walls, or, if one is not sent among the fittings accompanying the boiler, leave the wall so that an opening can readily be made to go in back connection and under boiler when an examination or cleaning is required. The stay rods, plates and other attachments should be put in as walls are advanced, the relative position of which is shown upon an illustrated circular from the manufacturer, which will be found in some of the boxes packed with the fittings. The space between back end of boiler and end wall should be 15 to 18 inches, with an arch turned to protect the back head, as previously described. The position of the bridge wall can be determined by the length of the grate bars, which may be laid down and measured, allowing one inch more for expansion at ends when in place. The furnace will vary in length from three to five feet, according to the size of the boiler and amount of power required. Approximately, half a square foot of grate surface gives a horse power. The bridge wall should be about 18 inches at bottom and topped off to about 12 inches at the top, following the circle of the boiler, and distant from it six to eight inches. These approximate figures are upon the supposition that coal will be the fuel used.

The setting should be done in a substantial manner, using hard brick with sharp lime mortar. The furnace and bridge walls should be laid with No. 1 fire brick, every fifth course a header. It will make a good job and assist in keeping it clean, if the space back of bridge wall is smooth paved; and the outside appearance may be further improved by putting a stone coping on outside walls. If the boiler is to connect with chimney, a breeching will make the connection across the front. If an iron smoke stack is used, do not let the weight of the stack rest upon boiler front, but put on a petticoat where it passes through the roof of boiler house, and let part of its weight rest upon the roof.

The Peoria, Ill., Water Works Committee have advertised for new pumping machinery at the water works; proposals to be received by the City Clerk before the 17th of February. The capacity of the new engines is to be 5,000,000 gallons per day.

A number of Camden, N. J., industrial establishments are employing additional hands and working at night to supply their customers. Some of the establishments have enough orders ahead to keep the men employed day and night for three months. Workmen's wages have been advanced in several shops.

The Catasauqua Manufacturing Company have just advanced the wages of their puddlers 25 cents per ton, and added five cents per day to the wages of the other employees. If the price of iron remains firm the wages of the men will receive another increase in about two weeks time.—*Catasauqua Dispatch.*

Rules of the U. S. Patent Office.

A revised set of rules for the U. S. Patent Office went into force Jan. 1, from which we make the following brief extracts.

All business with the office must be transacted by writing, and all letters addressed to the "Commissioner of Patents," Washington, D. C. All matter sent to the office whether by mail or express must be prepaid, otherwise it will not be received. A fee of $15.00 must be paid on filing an application for a patent on an invention or a discovery, and an additional $20.00 on the issue of the patent. A copy of the specifications and drawings of any patent which is in print (including all for several years past) will be mailed to any address in the U. S. for 25 cents, twenty or more at 10 cents each. No patent granted since March 2, 1861, can be extended except by act of Congress.

A patent may be obtained by any person who has invented or discovered any new and useful art, machine, manufacture, or composition of matter, or any new and useful improvement thereof, not known nor used by others in this country, and not patented nor described in any printed publication in this or any foreign country, before his invention or discovery thereof, and not in public use or on sale for more than two years prior to his application, unless the same is proved to have been abandoned; and by any person who, by his own industry, genius, efforts, and expense, has invented and produced any new and original design for a manufacture, bust, statue, alto-relievo, or bas-relief; any new and original design for the printing of woolen, silk, cotton, or other fabrics; any new and original impression, ornament, pattern, print, or picture to be printed, painted, cast, or otherwise placed on or worked into any article of manufacture; or any new, useful, and original shape or configuration of any article of manufacture, the same not having been known nor used by others before his invention or production thereof, nor patented nor described in any printed publication, upon payment of the fees required by law and other due proceedings had.

If it appear that the inventor, at the time of making his application, believed himself to be the first inventor or discoverer, a patent will not be refused on account of the invention or discovery, or any part thereof, having been known or used in any foreign country before his invention or discovery thereof, if it had not been before patented or described in any printed publication.

The specification is a written description of the invention or discovery, and of the manner and process of making, constructing, compounding, and using the same, and is required to be in such full, clear, concise, and exact terms as to enable any person skilled in the art or science to which it appertains, or with which it is most nearly connected, to make, construct, compound, and use the same. It must conclude with a specific and distinct claim or claims of the part, improvement, or combination which the applicant regards as his invention or discovery.

The following order of arrangement should be observed when convenient in framing the specification, such portions as refer to drawings being omitted when the invention does not admit of representation by drawings:

(1.) Preamble giving the name and residence of the applicant, the title of the invention, and the statement required by the last clause of Rule 39;

(2.) General statement of the object and nature of the invention;

(3.) Brief description of the drawings, showing what each view represents;

(4.) Detailed description, explaining fully the alleged invention, and the manner of constructing, practicing, operating, and using it;

(5.) Claim or claims;

(6.) Signature of inventor;

(7.) Signatures of two witnesses;

The applicant, if the inventor, must make oath or affirmation that he does verily believe himself to be the original and first inventor or discoverer of the art, machine, manufacture, composition, or improvement for which he solicits a patent, and that he does not know and does not believe that the same was ever before known or used; and shall state of what country he is a citizen, and where he resides.

Benzoline Tricycle.

An ingeniously-contrived car or vehicle is described in some of the British newspapers, the body being of a light form of construction, and the arrangement of wheels like a tricycle. The motive power, concealed in the body of the vehicle, is obtained by the combustion of benzoline, a small jet of which is admitted into a burner about the size of a chimney-pot hat, the steam passing into the cylinders of a small torpedo engine, which rotates a horizontal shaft. There is no steam given off, for it is recondensed and passes back into the tubular boiler. The weight of the steam power is about 180 pounds. On lighting the benzoline, the steam requires no attention from the driver during a ride of many hours, and by applying his foot to a pedal he can regulate the speed and power of draught. It travels at the rate of about eight miles an hour, and is easily directed in its course.

Ten of New Jersey's fifteen blast furnaces are now running, and three more will soon light up, while all the iron mines in the state are being worked.

Pounding in Steam Engines.

BY EGBERT P. WATSON.

If a steam engine is properly made and erected it should work smoothly and noiselessly in all parts, no matter how high the speed. They do not always work so, and it is evident to the experienced observer that there is something amiss that there is no occasion for, which a little search would reveal. If it were only the noise given out by a pounding engine, the annoyance would be great enough to call for speedy suppression; but the pounding alluded to is *prima facie* evidence that a loss is entailed somewhere by its existence. The first impulse of an inexperienced engineer when his engine pounds, is to get a copper hammer and key up the connecting-rod, though it did not need this attention at his hands, as it was not the cause of the row. When he finds this does not mend the matter at all, he then keys up the cross-head end. In all probability the noise is then just as bad as at first, so he stops and thinks a minute: "It must be the pillow-block, the shaft jumps in it, and that makes the noise;" so he screws down the binder, and sets up the jam-screws in the side chocks. Now he has it all right. So he waits a minute and listens—"*tunk, tunk!*" It pounds worse than ever, and by this time he has added about ten horse-power in friction to the load, and still is as far from the source of the trouble as before. What shall he do? If he is a man who knows nothing about his calling, and cares less, he will say, "Something's wrong about the devilish thing, and I'll be darned if I can see where;" but if he is one who feels that for every effect there is a cause, he will not rest until he corrects it, and perhaps it may not be amiss to give him some hints here as to the cause of pounding.

The working parts of most engines in considerable service have been worn more or less out of truth, so that they no longer act as smoothly as when first erected. Crank-pins and shafts of horizontal engines, especially those worked at high expansions, are often by no means round; a sixteenth of an inch is not an uncommon irregularity. They become flat on the sides opposed to the greatest strain from the incoming steam, and when they are in this condition it is useless to key them up or run them until they are re-turned.

Again, the out-board end of the shaft, which is generally carried on a brick foundation, is very apt to drop from the continued strain and jar of duty. This dropping, of course, affects the alignment of the shaft, and throws the crank out of line besides; this twists the connecting-rod from one side to the other, and is a very common cause of noise. The remedy for this, it is plain, is to line the engine up again. It sometimes happens with engines that have small clearances in the cylinder, that the piston actually strikes one head or the other from the wearing away of the various connections. The remedy for this is to either put in new boxes, or back up the old ones so as to make the rods of their original length.

By far the most common cause of pounding in engines, however, is in the valve or valves. If there is not enough lead on the valve, it is easy to see that all the lost motion in the various parts is taken up by the fly-wheel on the return stroke, and noise is the result. Keying up will benefit this somewhat, but not entirely, for it is impossible to take up all the lost motion. If there is not enough cushion on the engine (which really amounts to lead in its effects) the same difficulty is observed. The remedy is to re-set the valves, and if the exhaust-passages are not right, to make them so. It is not unusual to find steam-engines in use that have been built to sell, not to run, and in these machines there is little or no attempt to produce any economy of working. If they make the fly-wheel go around it is as much as the purchaser expects. If a good engineer is so unfortunate as to get one of these traps to run, and finds it in bad condition, let him make it as good as he can in his own time, not in his employer's; for, if he stops the engine from any cause, short of a man in the shafting, the employer is very apt to tell him he does not know his business, and hire some one to fill his place.

Very often a steam-engine makes a bad exhibition of itself from no particular derangement of great moment, but from a complication of minor ones; a slight want of truth in some parts; a little delay in the valve movement; a weakness in some of the castings that compose it, so that they spring and buckle under strain so much as to throw other parts out of line. The discovery of these troubles and the rectification of them constitute the functions of a good engineer, and the remedies are usually special, not general, so they cannot be set down here.

Improved Lumber Sawing Devices.

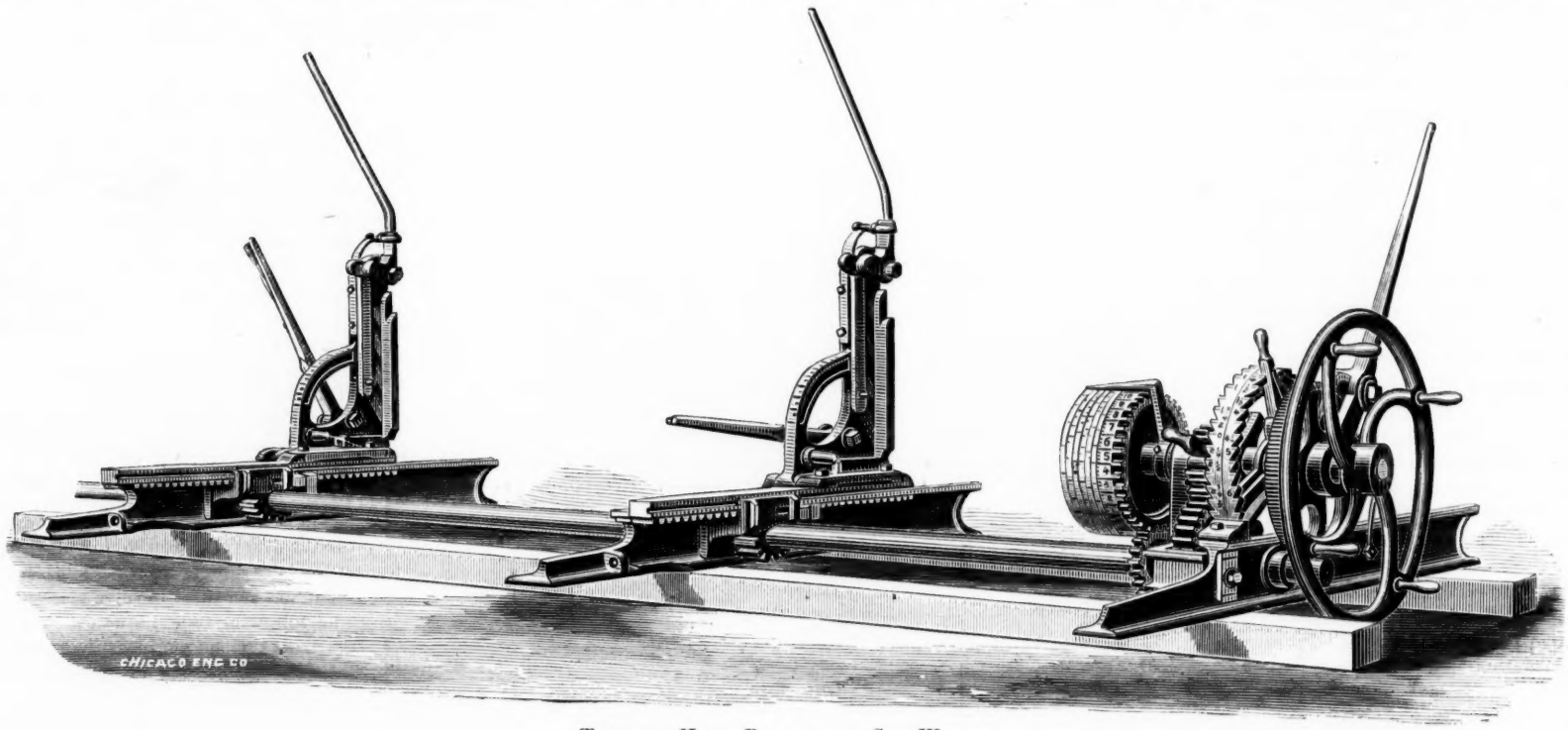
In the prompt conversion of logs into lumber for building, the accuracy and durability of the machinery employed is of the highest importance. On this page we present an engraving of the Triumph Head Blocks and Set Works, made by D. J. Murray, Wausau, Wisconsin—devices which have gained a good reputation among lumber mills. The set works are placed on the head of the carriage, four feet from the first block, the setter to ride on the platform. The blocks are operated either by the lever or hand wheel. Each knee has an independent movement, and any one of them can be set ahead of the others by ¼ inch up to five inches, by a geared lever attached to the knee which is shown in cut, one knee set partly forward. This knee can be moved at the will of the operator without loss of time, which is very convenient in sawing tapering stuff or butt logs.

The dogs are opened by a cam movement, which is an important feature, as they gather the stock to the knee instead of crowding away. They hold a round log as well as the last board. The bits of these dogs are made of steel with a circular form on the lower side, and straight on the top. The dogs, after entering the cant, begin to recede or draw the lumber tight and firm to the knee till the last board is sawed and the dog withdrawn. The dog holds as well in the side as on the top of a cant, thus holding the bottom as well as the top. To saw two boards from a plank quickly with safety, it is drawn tight to the knee. This cannot be done with the long dog without bending the plank so as to saw both boards crooked. To spoil two boards in every log, is to spoil about one-tenth of the lumber, or more than one thousand feet daily from this cause alone.

There is usually a loss of time, some danger of accidents, and some waste and crooked sawing in finishing the log; but by the general arrangement of these blocks, the last part of the log is sawed just as easily and as well as the first.

These head blocks and set works are provided with a graduated scale making provision for side boards of all kinds of bill stuffs, with a ratchet indicator or quadrant mark to correspond with the scale, also an adjustable ring lever top combined with quadrant to gauge the throw of set lever; thus making the work so plain that any man who can read figures can set the machine with either hand wheel or set lever, without loss of time or waste of stock.

The joint set lever is pivoted above the ratchet by means of a bolt passing through the upper and lower half of lever forming a joint in the lever. The lower end of the upper half of lever is the pawl that engages the ratchet. This device enables the lumber to be cut by variations of $\frac{1}{16}$ of an inch, from "commons" to "uppers" and from "scant inch" to "plump inch." It can be varied for thick and thin saws, also for thicker grades of lumber by means of a simple trip device connected with a set lever. A recent improvement in these blocks enables the operator to set every twenty-fourth of an inch of the scale with the same rapidity and reliable accuracy that each particular size was set heretofore. All parts are made interchangeable by means of standard steel gauges.



TRIUMPH HEAD BLOCKS AND SET WORKS.

A grain elevator, with a capacity of 250,000 bushels, is about to be erected at Atchison, Kan., by the Atchison, Topeka & Santa Fe Railroad.

Theory and Practice.—Ignorance of First Principles.

BY CHAS. A. HAGUE.

At every hand, and at all times, whenever we may take the trouble to exercise our powers of observation, evidence is presented of the absence of a knowledge of what might be termed "first principles" of mechanical cause and effect.

The extreme theorist, whose speculations are built almost entirely on the published opinions of those he calls "Authorities," does not take much trouble to assure himself as to the similarity of conditions existing in his own case and that of said authorities. By way of side issue, perhaps, it may be pertinent to remark, that, the variation of conditions under which any certain operation is performed, constitutes, in some cases, the slight mist that half obscures, and magnifies, and in others the dense fog that leaves us totally uninformed as to our whereabouts.

Theory, which bears a somewhat similar relation to practice that steam does to water, is simply *the law of fact*, and must always be deduced from fact; if now, we obtain a correct comprehension of the fact, and in a majority of cases we do not at the first obtain it, a course of reasoning may be followed and a theory established, that will very materially aid us when we again observe a similar effect. But when it is realized how often the reasoning faculties, unless subjected to a long, careful training, misconstrue the evidence which the senses receive and transmit, it is not a matter of wonder that so many wrong conclusions, based upon false premises, are continually being encountered.

At the risk of being charged with lecturing on "Intellectual Philosophy," the writer will remark, that, the senses of seeing, feeling, hearing, etc. are the instruments by which evidence is presented to the reasoning power, and if a wrong conclusion is drawn from the evidence, the fault lies with the reason, and not with the senses. The ability of the reason to weigh each particle of evidence, and allot to it its correct value, is the gauge of precision, by which minds must be compared. This power of "exact valuation" can only be acquired by experience, however well cultivated the mind may be. Amid the sound of moving machinery, the trained intellect will receive instant notice, by means of the sense of hearing, of any unusual noise and judge of its whereabouts and cause with remarkable quickness and precision; but we will resume our subject.

At the other extreme of the line, is the self-styled "practical man," who is so ignorant that he is unaware of his own short-comings, and who, after a certain age, becomes thoroughly case-hardened in his "views." He, of course, has abilities in his own peculiar line, but arrives at most of his conclusions

by the art of "guessing." If he builds a machine he puts in sufficient metal to make two, making safe against break-down to be sure, but never entertaining the slightest suspicion of proportion; or he may make some parts so weak, that it is necessary to "brace up" the contrivance with numerous sticks of timber, to keep it together when the belts are on.

Debating with the "practical man" is discouraging; his conclusions are all formed, and no possible discovery can modify them one whit; his mind is too inelastic to grasp new ideas; he meets reasoning with stubbornness, and, however convincing an argument may be to a man who uses his wits, with the p. m. whatever disagrees with his "creed," must be wrong somewhere. To sum up his weakness in few words, he is densely ignorant of "first principles."

Between these two extremes of character, is the man who "never grows too old or too wise to learn;" he sifts the information which is constantly coming to his senses, holds fast to that which is new or valuable and promptly rejects that which is of no account. He is, of course, his own judge of quality in the operation, but experience and observation are his trusty allies. He studies the laws of nature and settles in his mind, as far as he can, the "first principles" of cause and effect with which his vocation brings him in contact; and when a difficult problem confronts him, he bases his efforts firmly on foundations that have been well tried and not found wanting; this mode of procedure is direct and to the point, and success follows as a matter of course.

A knowledge of the laws of ordinary natural forces and effects should form a part of the stock in trade of every mechanic; but a deplorable absence of such knowledge is constantly making itself manifest. The effect known as "vacuum" is very little understood, and it is safe to say that not one in fifty machinists and engineers who are witnessing its useful operation every day, have any clear or comprehensive ideas about it. The writer is acquainted with an engineer (man in charge of an engine) who holds a responsible position in his calling and is comparativly well informed on steam machinery, but who imagines that the vacuum gauge indicates *thirty pounds pressure*, and expresses it (vacuum) as exerting *fifteen pounds on each side of the piston*. I call to mind another case of an assistant engineer, on a steamship of one of the N. Y. and N. O. lines, who held firmly to the idea that if the glass covering the face of gauge should be broken, the vacuum would be destroyed, and the engine would "get hot." The writer wagered the price of a new glass that such would not be the effect. Wager was accepted; but instead of glass being broken it was removed by unscrewing the rim, and to the astonishment of A. E., the gauge kept right on indicating 27½. He could not understand it, and crawled out of his bet on the ground that the glass was not broken. Probably the most ridiculous part of the affair is, that when some one who "knows it all," is talking at a great rate about engines, vacuums and things, if the question is put in regard to effect of breaking the glass on gauge, the smart one is generally compelled to scratch his head and "think about it."

One more specimen, and we will let the engineers (?) off for the present. It was on board one of the North River beam-engine boats; adjustments of the exhaust eccentric were being made, and by some carelessness the set-screws were left "slack;" the crank was turned from one center to the other; eccentric moving but little, but did move just enough to make a complete reverse of the exhaust motion; the screws were "set up" at that, and somebody must have been very blind to have overlooked the fact that the screws were perfectly slack after engine had been moved. This was at night. Next morning a start was made, and when the hooks were dropped the exhaust valves let the steam out as fast as induction valves let it in. That engine "got hot" quicker than if the whole vacuum gauge had been smashed. The boat was worked five miles by hand, to the next landing, and there an hour and a half was consumed *in trying* to set that eccentric. The *trying* was done by looking for chisel-marks on the shaft and corresponding ones on the eccentric; the engineer (?) did not know enough about "first principles" to assume from position of crank, the approximate position of eccentric, and make closer adjustments afterwards, but he just followed his nose, and *tried* the engine at every blessed chisel-mark he could find, until he happened to reach the right one.

Among the articles that have to be dealt with strictly on "first principles," might be mentioned shafting and belting; there is more mystery and humbug indulged in over the lining of shafting and placing of belting, than over any two common things in the business.

A new machine is to be placed and started; the direction in which its driven pulley is to run is known; a place must be selected convenient for the work to be done, and then comes the question of countershaft. Will the belt from line shaft be "open," or "crossed"? It is not an uncommon sight to see a man describing circles in the air with his forefinger, indicative of the motion of pulley from which he is to belt, and after going through a certain amount of this sort of thing, decide as to the belt, sometimes coming out all right, and sometimes all wrong.

For some purpose or other, it is necessary to know in which direction the pulleys on a certain line shaft revolve, and, not being in sight of said shaft, our intensely practical man begins to move his finger through the air, in a direction corresponding to that of belt-wheel on engine shaft. He follows the main belt in his mind, until he comes to the jack shaft. He "indicates" jack shaft, but don't notice that his finger is still "revolving" in the same direction, his mind having shifted, as it were, from main to jack shaft; and he catches the motion of the latter by remembering in which direction the upper face of a certain pulley passes a certain post or beam. In this way he continues until he finally reaches the line he wants, and then to make sure, he goes up stairs to take a look, and in making various turnings on his route, he don't know whether the motion he has decided on is correct or not; in fact don't care, because now he can see the shaft. So he forgets his calculations, only to resume the same operation the next time he wants to know the motion of a shaft. Now the most notorious fact about this operation is, that in a majority of cases the i. p. m. gets his mind revolving in the wrong direction, unless there is a friendly cross-belt, or a pair of gears, that he has forgotten, between the engine and the line he is figuring on.

As a sort of moral to the above, a way is suggested by which the motion of pulleys may be always remembered without unnecessary delay. There is nothing particularly brilliant about the method, and all who have a better one needn't use it. It consists briefly in firmly fixing in the mind, the direction in which the crank pin of the engine moves, at the highest and lowest point of its travel, the end of a crank pin being a distinct object. Its motion can be more easily brought to mind than the continuous rim of a pulley. The pulleys on any shaft in the establishment, if the lines are all driven by "open" belts, will of course revolve in same direction as is indicated by path of crank pin, and to decide which is the "pulling side of the belt," it is only necessary to remember that the top and bottom face of pulley moves in the same direction as crank pin in top and bottom positions of its circle. If the jack shaft or the first line is driven from engine shaft by gearing, of course the conditions are reversed, but would be quite as easy to keep track of. The main driving belts to line shafting are generally not crossed and in fact never should be. If the establishment is driven by water power, it is obvious that some other simple reference point would be necessary.

Experiments with Steam Yachts.

BY RICHARD H. BUEL, C. E.

The accompanying figures represent some of the indicator diagrams from the cylinders of two small steam yachts; one, the "Fairy," built by the N. Y. Safety Steam Power Co., and the other the "St. Remy," built by Ward & Stanton, of Newburgh, N.Y. They are presented with the idea that they will be of interest to owners of steam yachts, and also in the hope of drawing out communications from others who have similar data in their possession.

Figs. 1 and 2 represent indicator diagrams from the upper end of the steam cylinder of the "Fairy," a yacht 35 feet long, and 7 feet beam, having a vertical engine with a cylinder five inches in diameter, and six inches stroke. Diagram No. 1 was taken with steam in the boiler of 100 lbs. pressure, and the throttle valve nearly closed, while in No. 2, the boiler pressure was 75 lbs. per square inch, and the throttle valve was wide open. The following table shows the power developed at various engine speeds, the experiments being made in a case where there was no wind or sea.

No. of Experim't.	Revolution of engine per minute.	Indicated H. P.
1	80	0.8
2	160	3.1
3	240	8.1
4	246	9.8

The remaining diagrams are from the engine of the "St. Remy." They were all taken with the throttle valve wide open, the boiler pressure being maintained constant for each series of experiments, diagrams 3 and 4 with a boiler pressure of 45 lbs. per square inch, and 5 and 6 with a boiler pressure of 60 lbs. Diagrams 3 and 5 are from the top end of the cylinder, and 4 and 6 from the bottom end. The "St. Remy" is 30.2 feet long, and 9 feet beam, and has a vertical cylinder 5.5 inches in diameter, with a stroke of 6 inches. In taking these diagrams, the link was shifted to various positions without producing any effect upon the steam distribution, and the diagrams are suggestive in many other respects, upon which it is scarcely necessary to comment.

In addition to determining the power of the engine, the speed of the yacht was also ascertained, by running over a measured distance in a quiet cove, free from tide. The "St. Remy" has a four-bladed screw, thirty inches in diameter, and 41.5 inches pitch. The table below represents the principal results of the experiments for power and speed:

Pressure of steam in boiler.	Revolution of engine per minute.	Indicated horse-power.	Speed of yacht in miles per hour.	Slip of propeller, per cent.
45	191	1.4	6.72	11.73
60	216	2.2	7.33	16.

Letters from Practical Men.

FINDING THE CENTER OF A HOLE.

Editor American Machinist:

Having received valuable hints in "Letters from Practical Men," I send sketches of two devices, which I have found of great value, and which I believe will be appreciated by machinists generally if once tried.

In finding the center of a hole that has been bored, especially a large one, the tin center piece on a wood cross-bar in general use, is not reliable, and cannot be depended upon for accuracy, for the reason that if the punch varies the least when struck, there is no remedy but to substitute a new piece of tin. If a large, heavy pair of dividers are used (which is necessary for large work), the center soon becomes so much worn in marking circles, that its accuracy is very much impaired. In Fig. 1 is represented a small steel disk *A*, three-quarters of an inch in diameter, one-sixteenth thick, with a raised center three-sixteenths diameter and one-eighth high, with a prick-punch mark in the center. Over this is placed the clamp *B*, made of one-sixteenth sheet steel, with a half-inch hole in the center, or one large enough to allow the disk some play for adjustment.

It is secured to the cross-piece with two small wood screws, just tight enough to allow the disk to be moved by a light tap, until the center is found, when the screws may be drawn up and the center made firm. This arrangement is capable of very fine adjustment.

Fig. 2 represents a pair of ordinary inside caliper legs, riveted together with the points both turned in the same direction, one leg being a little longer than the other, so that it will project over the work slightly, and the calipers remain square. It will be found very useful in measuring from a base to an upper face, or from an inner to an outer face, especially when a projection of any kind intervenes, and in numberless other ways that will readily suggest themselves to the practical mechanic. J. J. NEWBAKER.

Steelton, Pa.

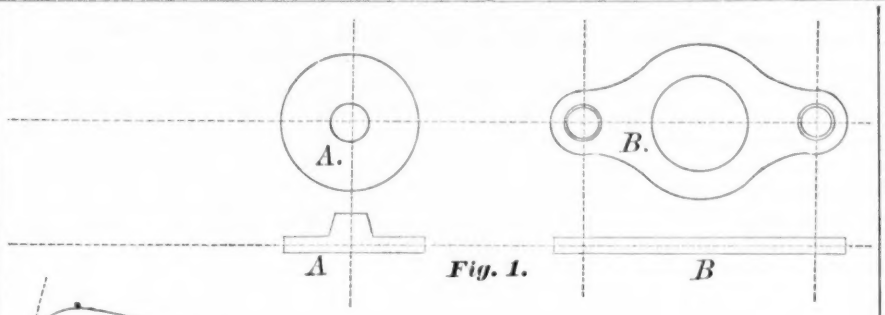


Fig. 1.

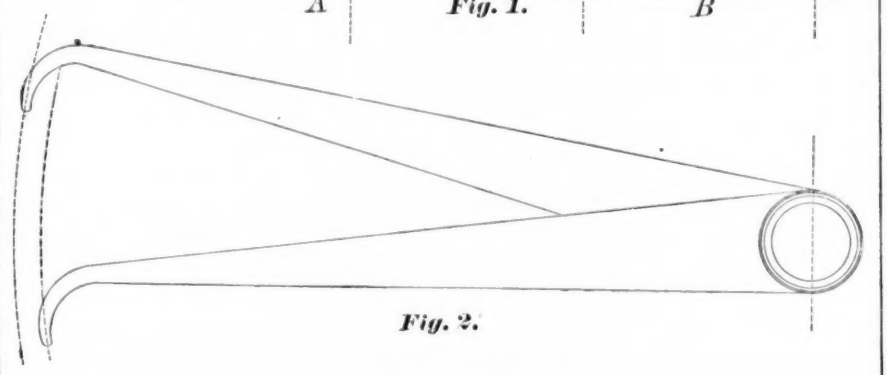


Fig. 2.

PROPORTIONING PORTS AND SLIDE VALVES.

Jan. 10th, 1880.

Editor American Machinist:

DEAR SIR.—I shall endeavor to give your readers a simple, direct and comprehensive method of proportioning ports and slide valves for engines of any diameter of cylinder and variation of piston speed; also of getting the proper throw of valve, together with the time of opening and closing of exhaust.

In nearly all rules given, it is supposed that either the lap or travel of valve is first known. Now, the lap and travel of valve determine the port openings, and either of them *affect* the port openings. But they are of *first importance*, instead of being treated as secondary. Most authors begin at the wrong end of the engine.

The first thing to be considered, in designing an engine, is the amount of work it is to perform; after this, the size of cylinder, together with the piston speed, steam pressure, and point of cut-off.

Suppose it is decided that the cylinder should be 16″ diam. by 30″ stroke, the piston to travel 500 ft. per minute=100 revolutions, and the cut-off to take place at ¾ stroke. This engine would give 90 H. P. As the port openings must be in proportion to the size of cylinder, together with the speed of piston, they should next be found. We may get their area from Porter's rule—that steam, in entering a cylinder, should never be required to travel faster than 200 ft. per second.

In consideration that longer ports require larger valves and wider ports more travel, either of which create more friction, it will be seen that port openings may be made too large as well as too small. I believe as good a rule as can be followed, for plain slide valve engines, is to suppose the piston to move at a uniform speed; the port to be at full opening all the time during admission, and velocity of steam 200 ft. per second.

The rule is:

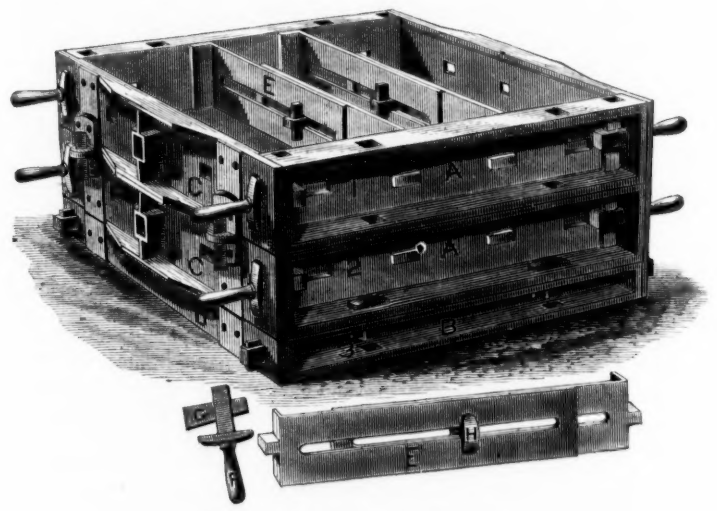
Multiply the area of cylinder in inches by the speed of piston in feet per minute, and divide the product by 12000. This will give the area in square inches required for "live" steam,

$$\frac{500\times200}{12000}=8.3 \text{ square inches.}$$

The exhaust steam should not have to travel faster than 110 ft. per minute. Make the steam port one inch wide, as shown in Fig. 1, and uncover it ¼″ by the "wing" of the valve. This is the full linear opening for "live" steam, while the exhaust has one inch linear opening. Divide the area 8.3 by ¼ which gives 11 inches as the length of port. The exhaust "throat" should be 2″ wide, for the reason that the slide valve covers it partly when at full stroke, as seen in Fig. 1. Make the bars ¼″, so that they will cast well. When the travel of valve is determined, the length, *e f*, of the face may be fixed. The valve should travel over the face at *f*, so as not to "shoulder." We have now found the full opening of port, and have decided upon the point of cut-off—¾. From these we can find the lap and travel of valve. Draw the vertical *y y* perpendicular to *a c*, cutting it in *e*. From *e* make *e b* equal to port opening. From 180° subtract one-half the arc traveled through by crank pin previous to cut-off. Divide the remainder by 2, and make the angle *e b c*=the quotient.

The arc traveled through by the crank pin previous to ¾ stroke is 120°, one-half of which is 60°. Make the angle *e b c*=

$$\frac{180°-60°}{2}=60.$$



SECTIONAL FOUNDRY FLASK.

Extend *b c* until it cuts *y y* in *c*. Bisect *b c* at *n*, and extend the perpendicular *n d* until it cuts *a c* in *d*. With *d* as a center, with a radius equal to *d b*, describe the circle *h c y*. From *c* draw *c d*—also *c g*—parallel to *a c*. *b e* is the port opening at full throw; *e d*, the lap; *b h*, the travel of valve; circle *h c y*, the path of eccentric; *c*, position of eccentric centers, when crank pin is at *h*. The angle

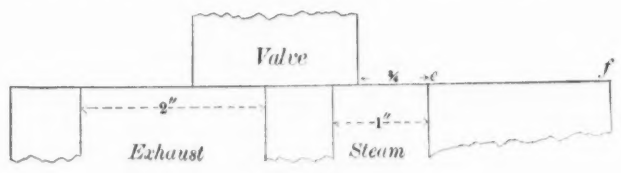


Fig. 1

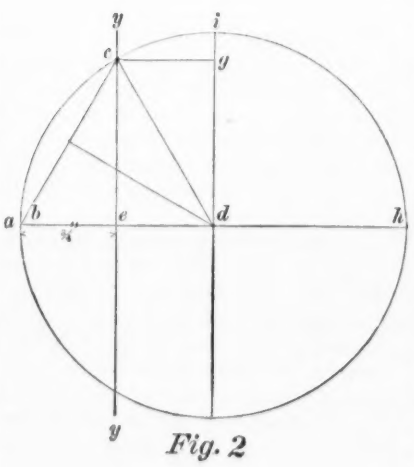


Fig. 2

g d c is the angular advance of eccentric. The *c g*, the linear advance of the eccentric, *g i*, is to the travel of valve as that part of the piston stroke, after the closure and opening of exhaust, is to the whole piston stroke. The angle *c d b* is the one-half arc traveled through by the crank pin previous to cut-off. Angle *d c y* measures the whole arc traveled through by crank pin previous to cut-off.

In the above there is supposed to be no lap on the exhaust side and no lead on the steam side. Neither is the angularity of the connecting rod taken into account. But the latter has nothing to do with the travel of valves or the proportions of valves and seats, but should be considered in the setting of valves.

By this simple process we have the following:

Cylinder 16″ x 30″	Throw of valve 3″
No. revolutions 100.	Lap outside ¾″
Cut-off, ¾ stroke.	Full port opening ¾″
Steam ports 1″ x 11″	Angular advance of
Exhaust port 2″ x 11″	eccentric 30°
Length *e f* of face	Linear advance ¾″
(Fig. 1) 2″	Exhaust closure 2.2″
Bars ¼″	

I can fully prove that the above is geometrically correct. The diagram Fig. 2, should, for greater accuracy, be drawn two or three times full size.

Leadville, Colorado. ED. F. WILLIAMS.

Iron Flask for Moulders.

In laying out a foundry it is of great importance to have a large yard for the purpose of storing the flasks.

The Pratt & Whitney Co., of Hartford, Conn., having realized this fact, were led to the invention of the flask which is represented by the engraving herewith. It consists of sections *A*, *B*, *C*, and *D*, the ends of which are planed and drilled to the same template, so that they are all interchangeable, and may be readily detached from each other, and as readily joined to make flasks of any desired size or proportion. The use of the same parts, in flasks of many different sizes, saves the accumulation of a large amount of dead material that occurs in every foundry that uses flasks made in the ordinary manner, saves storage room, and facilitates work. The flask-room used for these flasks is fitted with racks, each of which is marked with the sizes of the pieces placed therein, which are also marked. All odd sized flasks which are not likely to be required soon are taken apart and piled in their respective places, and when any emergency occurs, a flask can be made in any shape or size to suit circumstances. The pieces are put together so as to break joints, and are built to any depth required. These advantages are readily appreciated by the practical moulder.

The handles *F*, are held by means of a nut instead of the key *G*, as the keys will sometimes work loose. On large flasks a plain bolt and nut are used in place of the handle. Slotted sides, or "upsets," E, are provided, and any number may be applied as shown, and as occasion may require. When adjusted, they may be held firmly by the bolt *H*, and the key.

Triangular-shaped pins are used for bringing the flasks squarely together, which are also bolted to the flasks, and may be readily removed as occasion may require. Both pins and sockets are made to fit the same holes, so that they may be changed alternately. Flasks may be built up from 2½″ to 4 feet high in an incredibly short space of time. The pieces are held together by bolts and keys, and the only tool required for this work is a hammer. All flasks above 26″ square are made with a square hole in the end, as shown, for the insertion of a pin or trunnion, to be used for convenient handling with a crane. These pins may be removed after the flask is placed so as to be out of the way.

The rough castings are furnished to parties wishing to use these flasks, or flasks fitted up for use are furnished as follows: Lengths increasing by 2 inches from 12 to 48 inches, and by 12 inches from 48 to 96 inches; cope and drag, 5 inches deep; upsets, 2½ inches deep, including bolts, screws and pins, 12×12 to 22×22 inches, 24×24 to 34×34 inches, 36×36 to 96×96 inches. Adjustable ends are furnished with 48 inch and larger flasks.

Several years ago, a number of enterprising citizens of Jacksonville, Ill., contributed capital and established car works in that city, equipping them with excellent machinery. The panic came before they were fairly in operation, the enterprise was abandoned, and the works have been idle until within a few weeks. Now a new company has been organized, called the Jacksonville Car Company, capital $50,000. Mr. T. C. Dutro, of St. Louis, has taken the management, and the works will soon be under way.

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NEW YORK, FEBRUARY 14, 1880.

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Cheap Power for Driving Machinery.

The leading problem in mechanical progress, upon the correct solution of which depend incalculable public benefits, is, What is the cheapest available power for driving machinery? It may be answered that the most economical power in one situation will not be so in another. What is desired is some system of power which can be employed, if possible, as universally as steam, and at less expense. While no one but a one-idea enthusiast expects steam power to be entirely superseded, a conviction is gaining ground, that for ordinary manufacturing purposes, even where water power can not be obtained, other and cheaper sources of power than steam may be made available.

During the past two or three years gas engines have gained prominent attention, and with the most recent improvements have, in many situations, proved much more economical than steam. But gas is not to be obtained outside of cities and villages, unless it be generated in private gas works, a plan scarcely deemed practicable, except where the gas is also required for illumination.

Our English exchanges mention a gun-cotton engine said to work at less than half the cost of the gas engine. If any important developments are made with this style of motor we shall take pains to fully inform our readers, as early as possible, of its construction and operation.

The petroleum engine, we believe, has not been developed to a point anywhere near its full capabilities. Petroleum oil is cheaper than gas, and can be obtained almost anywhere without difficulty. Engines of this class are used, in many places, for pumping water, and styles have been constructed that work measurably well for driving machinery where motors of less than ten horse power are needed. The improvement and enlargement of oil engines seems to be a promising field for the efforts of progressive mechanical engineers.

Hot air as a motive power possesses, within certain limited capacities, advantages that should not be overlooked, but, like all the motive powers above mentioned, save water, it requires the steady consumption of some kind of fuel. It is to provide a motor *consuming no fuel*, and not requiring the force of descending water (which can be had only in favored localities)—one that is no more limited in its capacity than the steam engine—that has engaged the highest originative talent of progressive engineers.

The Keely motor has, doubtless, been laid carefully away for preservation, but Philadelphia is now to be favored with a wonderful spring motor, to manufacture which a stock company, with half a million dollars capital, is to be organized in that city. We would not advise any one requiring power to wait for the spring motor to be offered upon the market.

A recent mechanical monthly in its first issue mentions a "new and giant motor" run by a mixture of bi-sulphide of carbon and petroleum, which gives a "tremendous energy" for driving engines. As a large part of our readers doubtless know, a few years since a New England establishment went into the building of bi-sulphide of carbon engines, but after thorough trial and the most persevering efforts, they were obliged to abandon that style of motor as a failure. It took fully a year after the concern put that motor out of their shops to build steam engines, aided by the most approved system of fumigation, to eradicate the "giant" odor from the place. Cats and dogs venturing into that shop were soon observed to leave with noses erect and caudal appendages depressed, and could never afterwards be coaxed to pay it a visit.

The oldest and simplest motive power, so far as we have knowledge of ancient utilization of forces, is wind. It was used at a very early date to raise water for irrigation, and to propel vessels upon the water. Its use for purposes of power has never been discontinued. Wind power costs virtually nothing. The machinery and appliances for its application alone necessitate expense. In some parts of our country, notably in the Western and Pacific States, windmills are common. But the force of wind is irregular, and is not therefore used where a steady and constant power is required. Recently, considerable thought has been given to the question whether wind power can not be stored up in reservoirs and used as steadily and constantly as steam. One idea logically followed another until the plan of an air compressor driven by a windmill was developed, and we are glad to note, one is about to be constructed and put to practical work by a party in this city who has ample means at his disposal. Wind can thereby be made to compress wind, and to exert its power under perfect control. Compressed air can be used for driving steam engines of either large or small power. Its use is not attended with danger, nor does it corrode or wear away the metal with rapidity. It can be stored up in reservoirs and used when wanted. We see no reason why this kind of power can not be applied very cheaply and effectively, and shall watch the experiments now in progress with unusual interest.

American and English Locomotives.

The following is an extract from a late issue of the *Iron Trade Circular*, Birmingham, England:

The purchase of American locomotives by railway companies in South America and the British Colonies is causing some anxiety and discontent among English makers, but the causes are neither permanent nor irremediable. The American engines are cheaper in first cost, partly by the use of cheaper and lighter materials, such as iron tubes in place of brass, steel fire-boxes instead of copper, cast-iron wheels, thinner boilers, and thinner tires; and till the expenses of repairs and renewals of the engines and permanent way shall have been analyzed and allotted to their proper causes, no fair comparison is possible with the English made engines. But the success of the Americans is due also to the custom of the trade, which enables makers to adopt fixed types of engines which can be cheaply repeated; and it is to be feared that so long as English engineers continue to design innumerable kinds of engines, the makers of this country will be handicapped in the competition with those who can make cheaply, and stock the various parts and accessories of their engines.

The American engines are made cheaper in first cost, by using lighter, cheaper material, and our contemporary should have said with better results, as it has been proved beyond dispute by actual tests on American railways, that iron tubes have an advantage of economy over brass tubes, and that steel fire-boxes give better satisfaction than any other.

Cast iron wheels with hollow spokes have been in use in this country for many years, but it has been found that solid cast iron wheels will answer all purposes, saving the expense of making cores, and the risk incurred through bad castings. The extra weight added seems to be an advantage rather than a detriment. These wheels have been, and are now being used by many of the principal railroads of this country, and thus far have not broken or caused any extra trouble. Instead of using iron $\frac{9}{16}$ of an inch thick for the shell of a locomotive boiler, as is done in English engines, iron $\frac{7}{16}$ of an inch is found equal to any emergency. We have no more locomotive explosions in this country in proportion to the number in use, than they have in England, though our boilers are made of iron an eighth of an inch thinner than theirs.

The difference in the thickness of tires is in favor of American engines, as a new tire, three inches thick, can be put on without applying any screws or rivets to hold it, trusting entirely to the shrinkage to prevent it from getting loose. We have seen tires applied in this way which have been worn down to one inch in thickness without getting loose.

It is pretty well known, both here and in England, that the Yankees can beat them on locomotives. The American engines are made lighter, with no unnecessary or extremely heavy parts, and, as our contemporary says, each of these parts can be easily duplicated. English engines are all built from different patterns, and are more or less complicated, according to the ideas of the builder. On account of the fewness of parts, ours are less liable to get out of order. This accounts for the American engines costing much less for running repairs than the English. In short, the first cost is less, the running repairs less, and whenever American locomotives have been placed in fair competition with the English, they have always done more and better work. It is generally admitted that American engines will run on English roads and do their work, but it is doubtful if the English engines were put upon American roads, that they could haul the trains and make the time required.

Machinery for Street Cleaning.

Under the new system of street cleaning, contemplated in Philadelphia, machinery is to be used in all the streets, even to the extent of using machines to lift and collect into a single heap the winrows formed by the sweepers. Mechanical appliances for street cleaning in all our cities would seem to present a good field for American inventors.

Telegraph and Telephone Charges.

To any unprejudiced person who will study this question, it must appear plain that the telegraph and telephone managers are standing, not only in their own light, but in that of the public. The telegraph companies started out with the notion years ago, that high charges and a small constituency were all that telegraphy had to expect, either then or in the future, and every absorption by them of a weaker rival has apparently fixed this idea more and more firmly in their minds. Acting upon this view, they have whittled out elaborate tables of rates, adding a few cents for every few miles of distance, here, there, and everywhere, as industriously as if transmitting a message 175 miles by wire really cost them a few cents more than sending one 50 miles. As a result, their tables of rates are as complicated as a war map of Afghanistan, and nobody thinks of taking the trouble to go to a telegraph counter, or of inquiring the rate (always considered a high-priced luxury) and sending a dispatch, unless under the spur of absolute necessity. The idea that telegraph blanks could be sold at a uniform price like ferry tickets, and that messages could be received and transmitted profitably to any part of the United States (east of the Missouri River) at the cost of the blank, say, 25 cents each, seems never to have entered the minds of the telegraph owners. If everybody knew exactly what a telegraph message would cost to any point, and nobody considered the rate exorbitant, every other man in the country would carry blanks around in his pocket ready for use, loan or sale, as men now carry postage stamps.

Let such a plan be adopted, and it is not too much to say, that where now *one* person uses telegraph facilities once a year, *ten* would use them daily and habitually. But the managers of this great modern invention are, strangely enough, fogyish, and afraid to try any broad gauge experiments in the way of either enriching themselves or benefiting the world at large.

The public should not lose sight of the fact, nor allow the telegraph monopolists to lose sight of it, that recent improvements in methods, actual or possible, have so cheapened telegraphy (notably the introduction of the quadruplex system, and the substitution of dynamo-machines in all the larger offices for the old plan of generating electricity by battery), that what a few years ago might have been considered an uncertain experiment, is now easily possible. The companies themselves are in no danger of forgetting that nearly all of the thousands of small offices at railroad stations throughout the country are run with little or no expense to themselves, as the operators are paid and the wires largely maintained by the railroad companies.

And so with the telephone. Its managers started out with less cash capital than would suffice to run a wholesale grocery business, and think themselves rich because this cap-

ital has appreciated ten times in value. In New York they charge $90 per annum for the use of an improvement which could readily be afforded at $2 per month. As a result, one firm in fifty, and about one family in five hundred use it. The privilege of talking through the telephone should be as cheap and as universal as the use of coal gas or Croton water. And so it is elsewhere—like city, like country. From present appearances, the telephone companies bid fair to be decades of years in introducing an invention, which but for the exorbitant rates at which it is offered, would be eagerly adopted by the whole people within a few months, on account of its convenience and intrinsic merit.

We frequently receive suggestions from our readers, indicating subjects which they desire to have treated in our columns. We are always glad to receive such suggestions, and to act upon them.

Neglect of the Common Roads.

Notwithstanding all our boasted mechanical progress in this country, there is one very important particular in which we are immeasurably behind the English, namely, in our failure to use the common roads for purposes of locomotion, speedy, or otherwise. Doubtless much of this neglect is due to our greater extent of territory, and the correspondingly greater distances that we have to cover, but this suggestion would seem to argue against, rather than in favor of our present practice.

A greater hindrance, albeit, one which to a considerable degree grows out of the foregoing, consists in the intolerable condition of the common roads, in most parts of our country, during a much larger portion of the year than is at all necessary. Farmers devote, say, two or three days' work per man each year to improving the roads, and keeping them in order, and then complain that they live lonely, secluded lives, that their crops cannot be moved, and that they are forced to pay higher prices for all they buy.

Business men in hundreds of towns and cities sit in their stores and mourn over unsatisfactory business, often apparently ignorant that the cause lies at their own doors, or in their own suburbs, needing nothing upon their part to remove it except clear grit and clean gravel. Each of these classes of grumblers seems to ignore the fact that mechanics and mechanism can be relied upon to relieve this enforced embargo, the moment the material conditions are made decently favorable.

From any progressive point of view, there would seem to be no good reason for any such absolute and helpless dependence upon horse-flesh and iron rails in the future, as has characterized our people hitherto.

The Time to Save.

Chordal continues in this issue the subject of machinists saving money. It is a qualification as much to be desired as that of being an expert workman to know how to live comfortably and save a little money out of moderate wages. A few machinists practice saving, while many spend every cent of their earnings, a considerable part of it before it is earned. Now, that good machinists are receiving good pay, the question of saving against a possible season of depression in the future is of vital importance to them. Every machinist who begins to save 25 cents a day might congratulate himself that he is getting that much advance of pay over his neighbor who spends every cent.

Lumbering Machinery in the South.

The lumber regions in the northwest are beginning to show serious signs of depletion, and the immense forests of Louisiana, and the Southern states generally, now bid fair to take rank as headquarters for lumbering. This means an early and growing demand for lumbering machinery in those regions. Our manufacturers should see the chance, and avail themselves of it at once.

LITERARY NOTES.

The opening of the year 1880 has been prolific in giving birth to new journals of the scientific or mechanical class, as well as enlarging, and otherwise improving several that were already established. We regard creditable additions to this field of journalism, as direct benefits to the community at large, aiding, as they do, to spread specific practical knowledge among the followers of various arts and industries.

The Scientific News, published semi-monthly, by S. H. Wales & Son, at 10 Spruce St., New York, "devoted to science, arts, inventions, patents, shop and household economy," was enlarged Jan. 1st, to 12 pages, 11×16 inches, and considerably improved in its typographical appearance, as well as in the practical value of its contents. The subscription is $1.10 a year.

The American Engineer, hailing from Chicago, comes out with Vol. I, No. 1, for January. It has 16 pages, and a colored cover, and is printed on extra heavy paper, with broad gauge columns, two to the page. It is devoted mainly to civil engineering. $2 a year.

The Milling World, a new 36-page monthly, published by C. A. Wenborne, Buffalo, N. Y., comes out as an addition to the already numerous family of milling journals. It is creditably edited, and presents a good appearance. $1 a year.

Blacksmith and Wheelwright is a new finely printed monthly, "devoted to the interests of blacksmiths, wheelwrights, carriage and wagon-builders, machinists, gunsmiths, and all workers in iron and wood," which is certainly a comprehensive field to cover. It is a 16-page sheet, which seems to possess the elements of success. We notice that Joshua Rose contributes three or four articles to each of the first two issues. We would suggest to the editor that when he again makes some extracts from an article in the AMERICAN MACHINIST, it would be more commendable, and in better taste, to give direct credit, rather than to "one of our exchanges." Published at 80 Beekman St., New York, at $1 a year.

The Practical American is the suggestive name of a new 16-page illustrated monthly, published by Dr. Van Der Weyde, formerly Editor of the *Manufacturer and Builder*. The first issue treats upon a variety of subjects, and will interest many classes of readers. Subscription $1.50 a year.

Business Specials.

Forty cents a line for each insertion under this head.

Manual of Power for Machines, Shafts, and Belts, with the History of Cotton Manufacture in the United States, by Samuel Webber, C. E., copyrighted 1879. Only work of the kind extant; 240 pages. Price $3. Address, D. Appleton & Co., New York, or the author, Manchester, N. H.

Lathe Attachments for Milling Plane and Irregular Forms; Taps and Reamers fluted and Gears cut without removing from the lathe centers. For extended description, see AMERICAN MACHINIST, Sept. 13 and 20 issues. Send for circular to Wm. Main, Piermont, N. Y.

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Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common sense methods.

(1) J. E. B., Boston, Mass., writes: I have, occasionally, from twelve thousand to fifteen thousand small pieces of steel wire to harden. What is the best way to heat them? *A.*—Place them in an iron vessel with a flat bottom, spreading them evenly; cover the vessel and place it in a furnace. When the desired heat is attained, empty the contents of the vessel into water.

(2) J. O. H., Bloomington, Ind., writes: I have a boat 17 ft. long, 4½ ft. wide, built very much like the common skiff used on the Western rivers. I wish to run it with an engine, the cylinder of which is 2½ inches diameter, 6 inch stroke—to run 300 revolutions per minute with a boiler pressure of 65 pounds. The boiler is copper and the engine is well made. What size propeller must I use, and what pitch, and how many revolutions should it be run, all work being well done? What speed would such a boat make in still water? *A.*—The cylinder of your engine is very badly proportioned to drive a propeller. It should be at least 3 inches in diameter for the stroke named. We do not believe you will get over 150 revolutions per minute, unless you carry a boiler pressure of 100 pounds. We advise you to use a propeller wheel 12 inches diameter, and a pitch from 20 inches to 24 inches, and run it as fast as you can, which is the only way to determine the speed in this case.

(3) S. P. M., Connersville, Ind., writes: 1st.—What is Caustic Soda? *A.*—Caustic Soda is a grayish-white substance, hard, very alkaline in re-action, and strongly corrosive. It is expressed in chemistry thus, Na H. O.; molecular weight, 40. It is composed of carbonate of sodium, lime, and water. 2nd.—What is meant by saturated steam? *A.*—Steam which is generated in an ordinary boiler without any superheating attachment. 3d.—What is the difference between a fixed cut-off and an automatic cut-off? *A.*—This question was answered in our issue of Sept. 13th, 1879. 4th.—The glass water gauge on our boiler often fills full of water, which is on account of the top connection being too low on the boiler head. How would it do to make the connection for top from the top of boiler shell? *A.*—Connections for a water column should always be made with the highest, and a low point on a boiler, but the bottom connection should be located high enough to prevent being stopped by the accumulation of sediment in the bottom of boiler. 5th.—Which is the best furnace to burn saw-dust, boards, and shavings from a saw and planing mill? Ought the furnace to be filled up from the bridge wall back, or would it be better to leave 3 feet from the boiler to bottom, back of bridge wall? *A*—A furnace to burn the fuel mentioned, to give the best results, should be of large capacity, with perforated grates. The pit, or fire bed, back of bridge wall, to insure perfect combustion and for other obvious reasons, should be from 4 ft. to 6 ft. deep, according to the size of boiler.

(4) H. C. J., Ontario, Canada, writes: Can you supply me with the following information? I want to know the exact diameter to the thousandth of an inch of the bottom of the thread of screw-bolts of both V and Franklin Institute shape of thread? *A.*—Formula for getting the diameter of V screws at the bottom of thread (Franklin Institute system) angle of thread 60°: Let D=diameter of screw.

" d= " at bottom of thread.

" N=number of threads to 1 inch.

Then $d=D-\frac{1.732}{N}$. That is, divide 1.732 by number of threads to one inch and subtract the quotient from the outside diameter. The remainder will be the diameter at bottom of thread. Example: ¼ in. screw, 20 threads, ¼=.25; expressed in decimals: $\frac{1.732}{20}=$ .0866. Subtracting .0866 from .25=.1634—the diameter at bottom of thread.

(5) J. T., Detroit, Mich., asks how much water in feet will flow into a vacuum through a pipe, say, for instance, for a steam fire engine? *A.*—The velocity with which water will flow into a vacuum is equal to that which a heavy body will acquire in falling through a height of 34 feet; namely, 46.52 feet. The weight of a column of water 34 feet high is equal to the pressure of the atmosphere on the area of the column. The rule to calculate the velocity is this: Take the square root of the height—34 feet, which is 5.8; multiply this by the constant number 8.021, which gives 46.52 feet—the velocity with which the water will flow into a vacuum.

(6) I. D. C., Fall River, Mass., writes: In a large mill in this city we have several lines of wrought iron shafting about 300 feet long, and making from 250 to 312 revolutions per minute. The engine is at the end of the mill, and the driven pulley from engine on end of long shaft. The couplings and flanges are keyed to the end of each section of the shaft and bolted together, and have not started in the least. The shaft tapers from 8 inches at engine, and 2 inches at further end. Several employees claim to have seen the farther end of the shaft stop still and instantly start again when a heavy machine is suddenly thrown on. Others claim it cannot fully stop. Will you please enlighten me? Is it possible for a shaft to twist enough and stop short without twisting off, when revolving so fast? How much can a shaft twist without injury to the iron? *A.*—It is not possible for a line shaft such as you describe, to have one part *stop still*, and then begin to move while another part of it is in continuous motion. When the belt of a heavy machine is tightened so as to bring a sudden resistance through the driving pulley to the line shaft, the torsional strain causes the pulley to lag or hang back (in its circular motion) of that part of the shaft nearer the engine. But the idea of its coming to a stop is an optical illusion, and cannot possibly exist in fact, for at such a high velocity, should any part of the shaft suddenly stop still, the other part revolving on, would instantly twist the shaft off. The amount a shaft can twist without injury to the iron depends on the quality and condition of the iron, and length of the shaft. The torsional strength of bars of like diameter is inversely as their length.

(7) G. W. C., Greenfield, Ind., writes: What kind of a crown sheet is strongest? A flat crown sheet with crown bars, or a circular crown sheet stayed to shell of boiler? *A.*—So far as strength is concerned, the crown sheet can be made as strong by one plan as by the other; but in regard to lasting qualities we should consider that the crown sheet stayed by the crown bars would be better, being self-contained, and not depending for its strength on the outer shell, which is liable to change its shape with heat and steam pressure.

(8) W. C. R., New Bedford, R. I., writes: Will you please inform me which are the best works on the Compound Engine? *A.*—Modern Compound Engines, by N. P. Burgh, price, $7.50, is a most valuable work on this subject. For cheaper treatises see our issue of Aug. 9th, 1879.

(9) E., Washington, D. C., writes: 1st.—I am seventeen years of age. I am a draughtsman in a patent attorney's office. I have a great desire to become a draughtsman in a machine shop. Will you please inform me, through the medium of the MACHINIST, how I can become such? Could I become one by entering the shop and learning the trade, then take up draughting afterwards? *A.*—If you have never taken a regular course in drawing, we would advise you to enter a school of mechanical engineering, where shop practice is taught in connection with the studies. If you cannot afford this we would advise you to serve your time as a machinist in the particular branch which you wish to follow; then enter the drawing office. In either case you will find the practical experience of inestimable value in your profession, and that it will give you important advantages over a purely theoretical education. 2nd.—Please state how much such draughtsmen get. *A.*—The pay of draughtsmen is conditional, and depends upon the qualifications of the man, the nature of the business, and the amount and quality of the work. The pay usually averages from $75 to $90 per month. 3d.—Would you advise me to give up patent office draughting to learn the other? *A.*—First decide in your own mind which you are best adapted to, and then, after selecting the profession, bring all your energies to bear in that direction, otherwise you will be a failure.

MANUFACTURES.

A Philadelphia manufacturing company has proposed to the city authorities of Rahway, N. J., if the city will give it a building site of eight or ten acres of land adjacent to the railroad, and relieve them from local taxation for a period of five years, to put up works employing from 600 to 800 hands, and to expend $1,000,000 or more in shops, machinery, and dwellings for workmen.

The Lawrence Manufacturing Co., of Lowell, Mass., have set six boilers with the Jarvis Furnace, and are about setting two more. They are putting in a 1,000 horse-power Corliss engine.

The Plume & Atwood Manufacturing Co., of Thomaston, Conn., will put in a new 600 horse-power engine in the spring, and also make extensive additions and alterations in their works.

The United States Wind Engine & Pump Co., of Batavia, Ill., are to furnish all the wind mills, pumps, outlet valves, spouts and fixtures for the extension of the Denver & Rio Grande R.R. The wind mills are to be the improved Halladay, and the pumps the Curtis double-acting.

Wm. Sellers & Co. have taken a contract for hydraulic machinery on a large scale, to be used in raising and lowering cars between the first and second stories at the proposed Fifteenth street depot in Philadelphia.

The Reliance Works of E. P. Allis & Co., Milwaukee, Wis., now employ a force of 700 men, and are running night and day.

George W. Prentiss & Co., Holyoke, Mass., have just begun an addition to their wire works—a narrow building 75 feet long—in the rear of their main mill.

J. Stevens & Co., of Chicopee Falls, Mass., propose raising the L part of their shop one story, giving room for their office, and adding about one-third more machinery to their present equipment.

The new mill of the Holmes, Booth & Hayden's Manufacturing Company at Meriden consists of a main building three stories in height, 124 feet in length and 50 wide, with a story and a half wing, 40x70, to be used as a muffle room.

The old Oxford, N. J., furnace is being relined and put into readiness for blast. The foundation of the old building was laid before the Revolutionary War, and the British cast cannon balls within its walls.

The well-known firm of McNeals & Archer, iron founders of Burlington, N. J., has been dissolved by mutual consent, by the withdrawal of Mr. Benjamin F. Archer. Mr A. H. McNeal's brother, W. E. McNeal, enters the firm in the place of Mr. Archer, and the business of the new firm will be conducted in the same place as formerly.—*West Jersey Press.*

Fairchild & Todd are building a shop 20x60 feet with wing 13x20 feet in Orange, N. J., in which they intend to put steam power and improved wood-working machinery.

Joseph F. Wangler, St. Louis Boiler Yard, 1019 North Main street, St. Louis, Mo., is full of orders, and doing all he can with men and room. He has now orders ahead for some time; among them 13 boilers of large dimensions and six very large tanks.

The Allentown Rolling Mill Company have leased the Glen Mill, Allentown, Pa., for a period of ten years. This company paid $30,000 to workmen at a recent pay day.

The Weissport rolling mill has been purchased by Albright & Stroh, of Mauch Chunk, Pa,

At Williams' iron foundry at Nashua, N. H , the number of hands employed is to be increased to 100, or 30 more than were employed a few months ago.

The Stewart Machine Company, of New York, have leased the Screw Company building at Hartford, Conn , and will take possession June 1st, giving employment to a large number of hands.

The Union Iron Works, San Francisco, lately built for the Comstock mines the largest pumping engine ever constructed on the Pacific coast.

It is a direct-acting compound pumping engine, with two upright cylinders standing at an incline towards each other. The initial cylinder is 65 inches in diameter, with 6 feet 9 inch stroke, and the expansion cylinder is 100 inches in diameter, and 8 feet 3 inches stroke. The 100-inch cylinder weighs 43 tons, and the smaller 30 tons. The fly-wheel is 37½ feet in diameter and weighs 110 tons, cast in 12 sections. The hub weighs 15 tons. The engine crank weighs 9 tons. The connection from engine crank to pump-bob is by an immense rod 24 feet between centers.

This engine is set on top of the ground over a pit, in which the great pump-bob works, the center of the bob being 21 feet below the engine beds. The bob itself is 48 feet long between centers, with a double wrought-iron truss extending around it.

The pump-rod is made of 18-inch square timbers, with 40 pieces of strap plates, each 33 feet long, 10 inches wide and 1 inch thick. The rod is intended to handle a line of pumps 3,000 feet. There are 6 balance bobs in the shaft, placed 200 feet apart, and arranged to handle 14 14-inch plunger pumps and a 20-inch diameter lift-pump at bottom of shaft. Its whole weight is 1200 tons.

Pusey, Jones & Co. are having a new wharf constructed at their marine railway, Wilmington, Del. There will be a frontage of 200 feet on the creek and the wharf will be built in a substantial manner heavily framed and cribbed, in order to make it a permanent structure.

The Fulton Foundry is building the machinery for the "Bryden" cooking ovens in Illinois. The plan of construction is essentially new, and when completed, it is said, more convenient, and well-built machinery cannot be found anywhere. It will be at least a month before all the machinery is completed and shipped. The foundry has just completed some blowers for the Missouri Furnace Company. A great quantity of work is said to be on hand.—*St. Louis Journal of Commerce.*

The steel mill of Park Bros. & Co., at Pittsburgh, Pa., is now illuminated at night with six electric lights and the effect is said to be very brilliant.

In Gardner, Mass., over 1,500 persons are employed at chair making, yielding over $2,000,000 of stock a year.

Chas. Waters & Son, Boston, are 100 governors behind their shipping orders, and have over 900 governors on their books to supply in future.

The citizens of Des Moines, Iowa, recently held a meeting to encourage manufactures, and appointed a committee to canvass the city for subscriptions to stock.

The Burdens are building an extension to their mills on the flats at Troy, N. Y., which will accommodate 23 more forges and give employment to 100 additional men.

The R. W. & O. R. R. will probably build new car shops at Rome, N. Y., in the spring.

Machinists' and Engineers' Supplies.

NEW YORK, Jan. 29, 1880.

Trade is brisk and tendency still upward on many lines of goods. Nothing is being reduced.

Boiler tubes are still quoted at 5 & 5% discount, but there is no longer any cutting, and prices are held firm at the quotations. In view of the recent advances in pig iron, a further advance is probable.

Wire Cloth changes daily with the price of wire; no stated price being quoted or possible at present. Will probably be advanced.

Manufacturers of rough and finished small tools, Wing Dividers, Calipers, Gas Pliers, etc. announce a change in discount to take effect Feb'y 1st, amounting to 10% advance.

Manufacturers of Machinists' Hammers will soon follow suit.

In Malleable Iron Steam and Gas Fittings a new list is announced, amounting to an advance of 25% to 33⅓%.

Steel Casting Brushes and Foundry Riddles, it is thought, will be advanced soon.

Heald, Sisco & Co., Seneca Falls, N. Y., write us: "Owing to the great advance in the cost of iron and other materials, we have found it necessary to advance the prices of our engines." The advance applies to their horizontal engines: the "Meteor" (10 H. P.), from $225 to $250; "Reliable" (20 H. P.), from $275 to $325; and "Hercules" (30 H. P.), from $375 to $400.

William Cooke, 6 Cortlandt street, New York, has taken the agency for Rue's "Little Giant" Injector, and has issued a circular giving full instructions for its use.

The manufacturers of wrought iron pipe, yesterday (January 28th), adopted the following revised price-list from which a discount of 35 per cent. is now offered. The result is an advance from previous prices of about 17 per cent.

WROUGHT IRON PIPE LIST.

Inside Diameter.	Plain.	Galvanized.
⅛ in.	.08	....
¼ "	.08	.11
⅜ "	.09	.12
½ "	.10½	.15
¾ "	.12½	.19
1 "	.19	.28
1¼ "	.27	.40
1½ "	.33	.47
2 "	.46	.64
2½ "	.75	1.00
3 "	.95	1.30
3½ "	1.25	1.70
4 "	1.50	2.05
4½ "	1.75	2.40
5 "	2.25	3.00
6 "	2.75	4.00
7 "	3.75	....
8 "	4.75	....

John Adt, New Haven, Conn., has issued a neat new illustrated catalogue of 24 pages, descriptive of his wire-working machinery, and hardware, and manufacturers' tools. It is accompanied by a neat price-list. In the preface he states that as much confusion has resulted from the use of six different wire gauges in this country, causing him, in at least one instance, serious loss, his preference is decidedly in favor of the new decimal system, as being the most simple, natural, and easily understood.

We have received a copy of the new illustrated catalogue of D. J. Murray, Wausau, Wis. It describes a number of wood-working machines, and gives prices of a variety of lumber mill supplies.

A. F. Prentice & Co., Worcester, Mass., have brought out a new engine lathe; swings, 11 inches; 5 ft. bed; weight, 650 lbs.; price, $175.

It is stated that Bemis & Call's Patent Combination Wrench will be advanced in price within the next thirty days.

Coe's genuine Wrenches have been advanced to discount 33⅓%, instead of 40%.

On Jan. 26th Planes were advanced to discount 25% for first quality, and 30% for second quality.

The American Screw Co. will sell at auction during February at 83 Chambers street, New York, 25,000 gross of second quality, flat-head, iron wood screws, assorted sizes; samples on exhibition.

Iron Review.

NEW YORK, Jan. 29, 1880.

As will be seen below, prices of Iron have again been advanced as predicted. The demand is active and figures firm, with every prospect of being well sustained.

Considerable foreign iron has come and is to come to this market, but it has been so far, and it is believed, will be readily absorbed without materially affecting the course of prices here.

Pierson & Co., 24 Broadway, New York, furnish us the following quotations out of store, under date of Jan. 29, 1880.

No. 1, X Pig, $42½ per ton; Iron Rails, $68 to $70, according to weight; Old Rails $44 to $45; Fish Plates, 4c. per lb.; Railway Spikes, 4¾c.; Bolts and Nuts, 5½c.; Common Bar Iron, 3 5-10c., basis from store; Refined, 3 8-10c., basis; Ulster, 4 5-10c., basis; Machinery Steel, 7c.; Best Tool Steel, 13½c.; Norway Bar Iron, 6c.; Norway Shapes, 6½c.; Nail Rods, 6½c.; Sheet Iron, 5c., basis; Angle Iron, 4 3-10c.; Tee Iron, 4 8-10c; Band Iron, 4½c.; Hoop Iron, 4 6-10c.; Horse Shoe Iron, 4½c.; Hot Polished Shafting in lengths, 2 ft. and longer, 9 to 10½c., according to size; Small Black Rivets 30% off in papers, 10% off in bulk.

Store prices to-day of boiler-makers supplies: Flange, 6¼c.; C. H. No. 1 Shell, 5¾c., C. No. 1, 4¾c.; Sheets, 5c. basis.

Metal Review.

LUCIUS HART & CO., 8 & 10 Burling slip, New York, furnish us the following, under date of Jan. 29, 1880:

The firm tone of the Metal Market has been well maintained since our last report. The volume of business has not been as large as during the preceding week. Straits Tin in London, £100.10/; Singapore, $32. We quote spot market to-day: Banca Tin, 26¾c.; Malacca & Straits, 24½c.; Australian & Billiton, 24¼c.; "Lamb & Flag," 24c.; Bar Tin, 25c.; Pig Lead, 6¼c., strong, for prime brands; Antimony exciting and advancing; "Cookson," 23c.; "Johnson" and "Hallett," 20c.; Ingot Copper, firmly held, 24¾c., spot, 25¼c. futures; Spelter, strong at 6¾c., either domestic or foreign; Nickel, $1.25; No. 1 Solder, 13½c; "Half-and-half," 15½c.

Situations Wanted—Help Wanted.

We will publish notices suitable for the above headings, applying to any of the machinery trades, and not to exceed four lines each (32 words), at the nominal rate of twenty-five cents for each insertion.

Foreman Machinist.—A Foreman Machinist holding first-class testimonials is open for an engagement; has controlled large bodies of men; 9 months experience in States. Address, R. M. B., Schenectady, N.Y.

A young man wants to get into an engine shop with a view of mastering every branch, and becoming a thorough mechanic. Address, W. F. Davies, 3110 Market St., Philadelphia, Pa.

Wanted at the Wausau Iron Works, Wausau, Wis., first-class machinists. Apply to D. J. Murray, proprietor, Wausau, Wis.

WANTED—Situation as foreman over a Machine Shop by a well qualified man. Address W. Fitton, Mount Washington, Bedford Street, Pittsburgh, Pa.

WANTED—A situation by an able and active mechanic and draughtsman of many years experience. Is thoroughly conversant with the Corliss system and the construction of special tools. First-class references given if required. Address A. P., American Machinist, 96 Fulton Street, N. Y.

Parties desiring a good practical and reliable machinist as foreman, who understands managing help and is well qualified for general jobbing or specialties, can find one by addressing A. S. Granville, Lawrence, Mass.

Wanted a situation by a competent Mech. Eng. and draughtsman as Supt. of Machine Shop or draughtsman, address A. E. W. care American Machinist, 96 Fulton Street, New York.

By a young and energetic mechanical engineer and draughtsman—a situation in some shop where he may learn the business. Has had considerable practice. Best of references given. Address, M., Am. Machinist Office.

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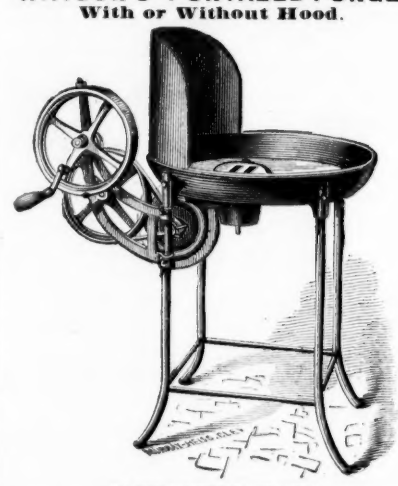

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Rare opportunity to purchase a complete set of the "Encyclopedia Britannica," 8th edition. Twenty-three books, bound in cloth, at $55.00. Also, a copy of The Practical Draughtsman's Book of Industrial Design, from the French, Armengand. By William Johnson, C.E.; 1860, in good condition, cloth, at $7.00.
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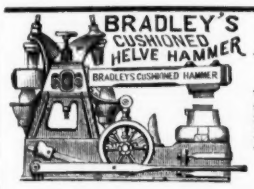

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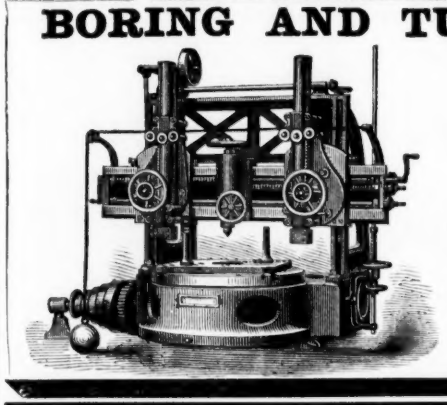

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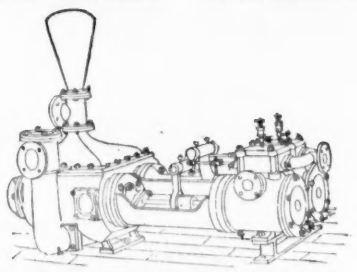

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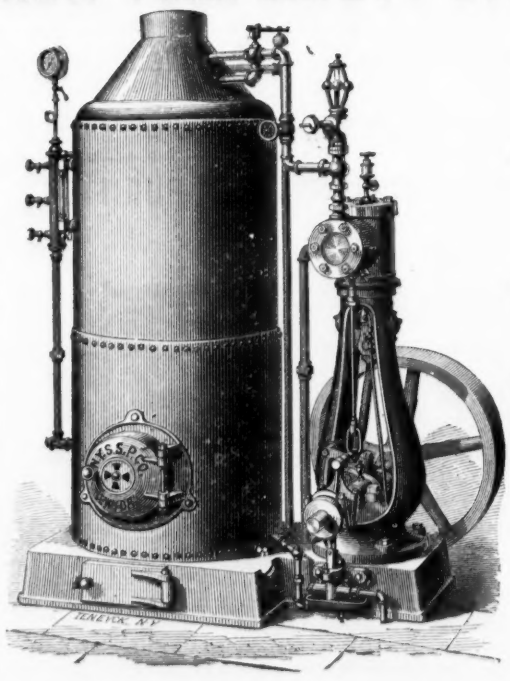

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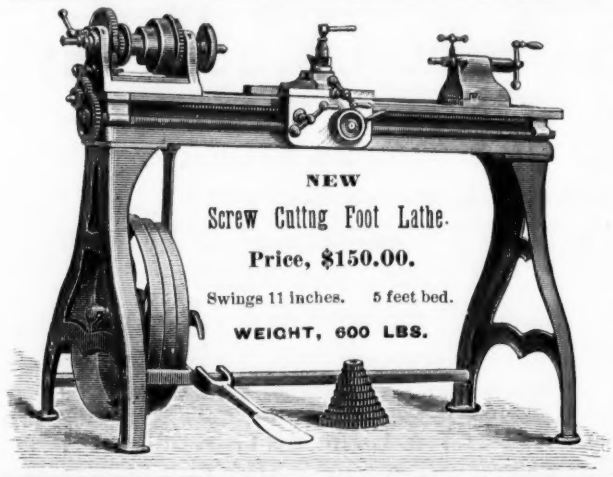

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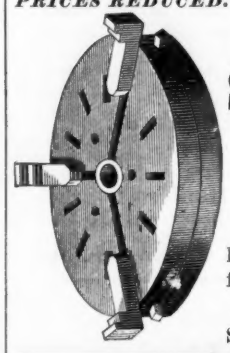

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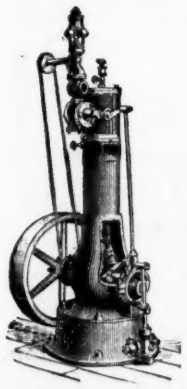

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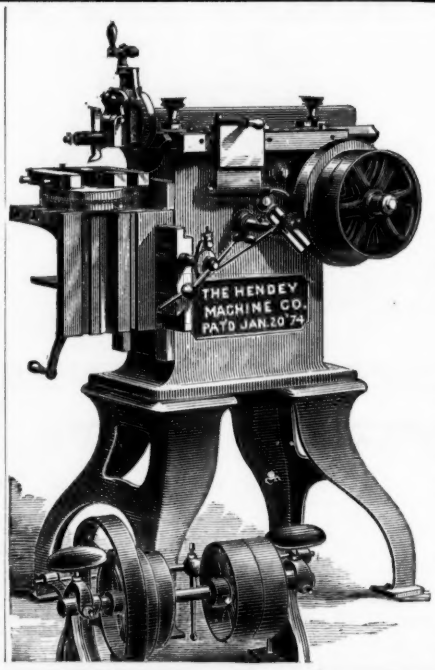

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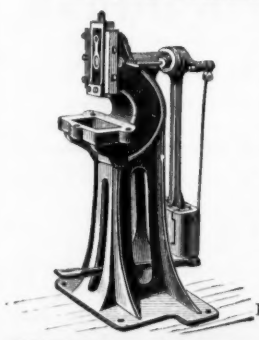

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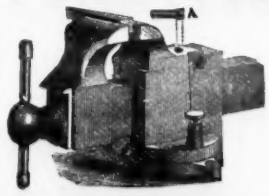

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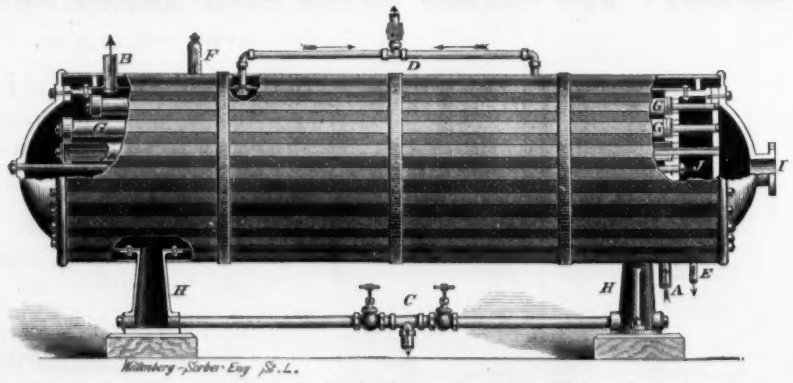

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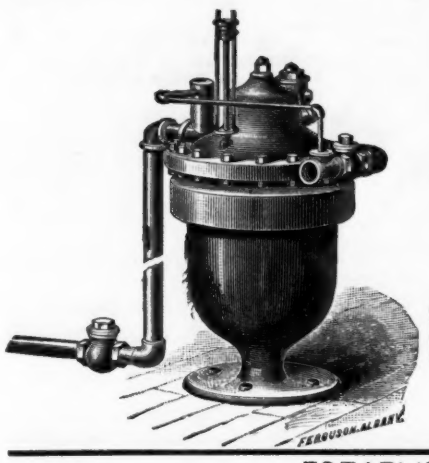

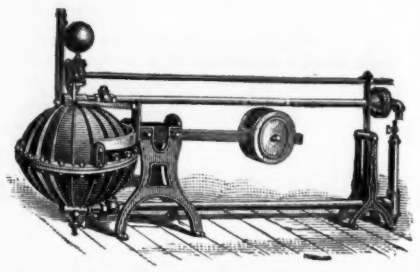

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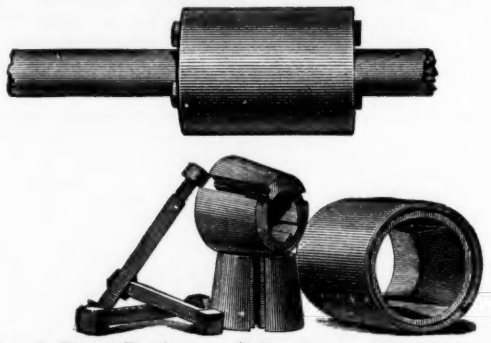

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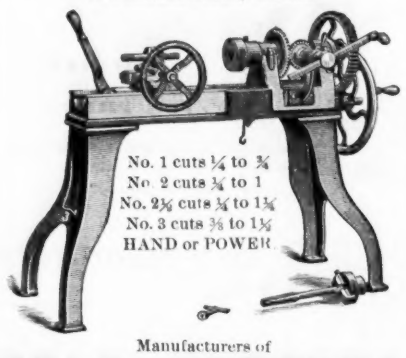

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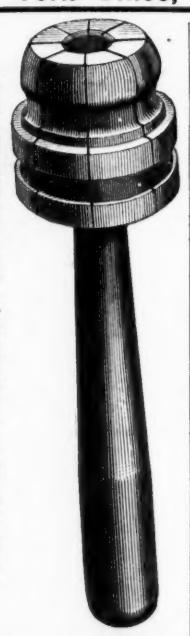

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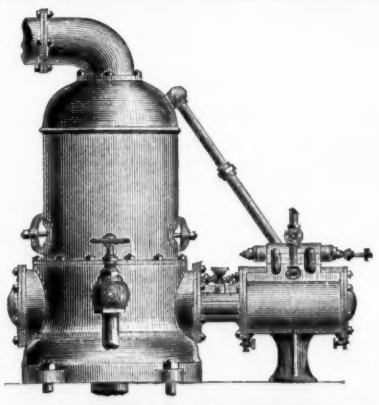

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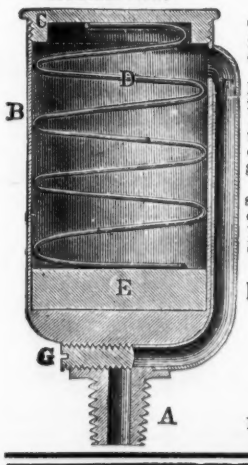

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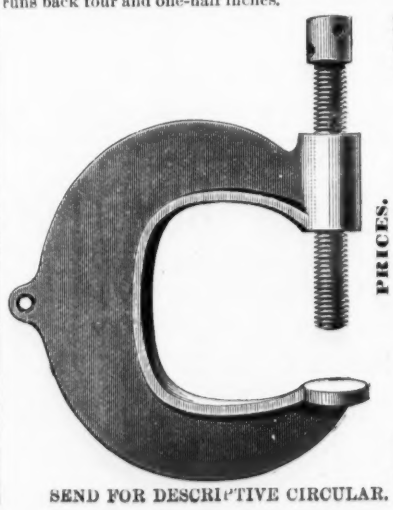

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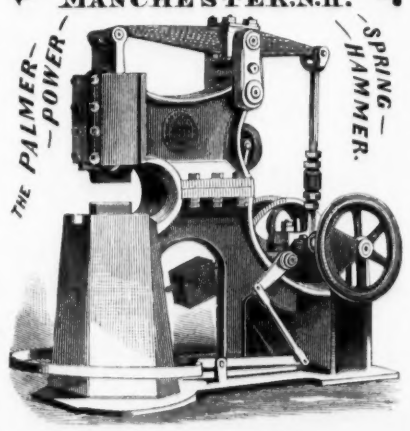

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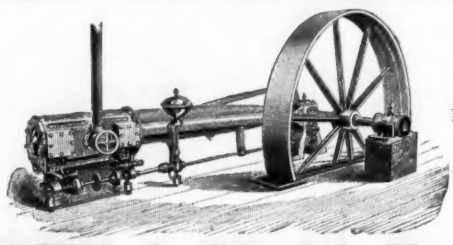

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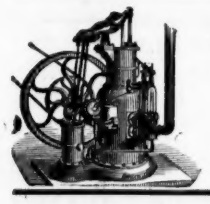

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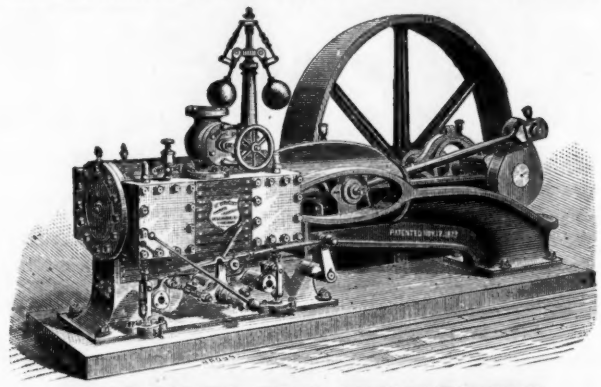

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[We desire to call particular attention to the above letter, as since it was received by us, Lieut. Mahan has confirmed his good opinion of our Engines therein expressed, by ordering two more of them.]

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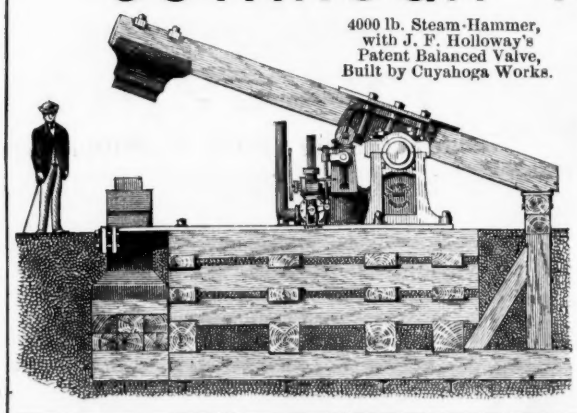

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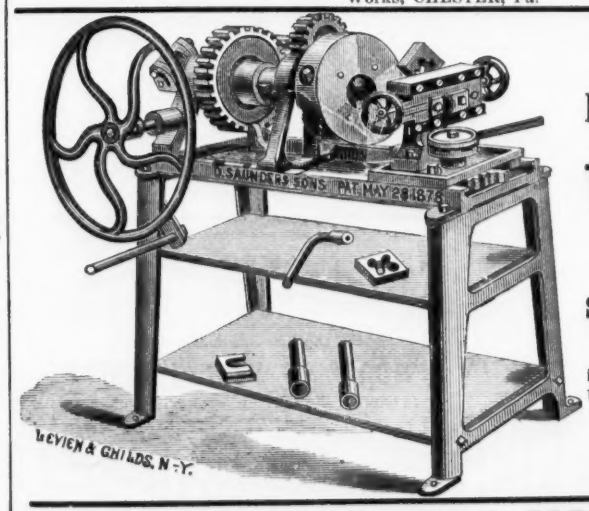

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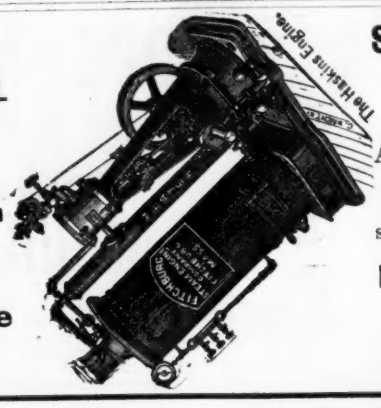

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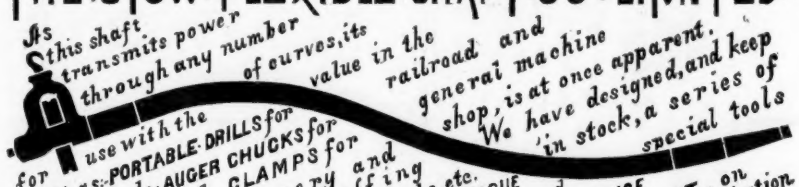
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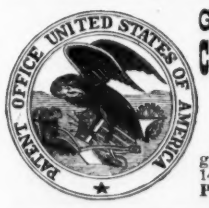

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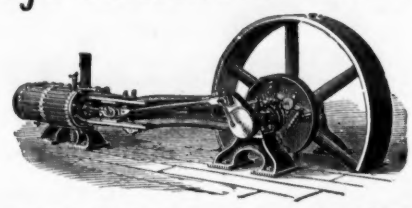

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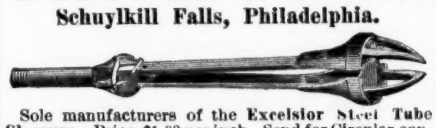

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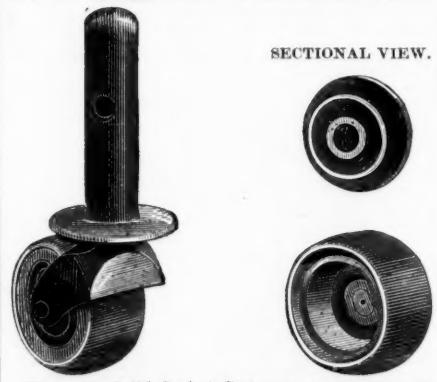

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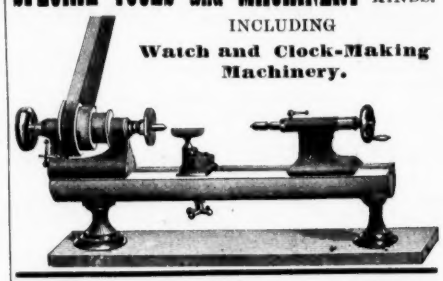

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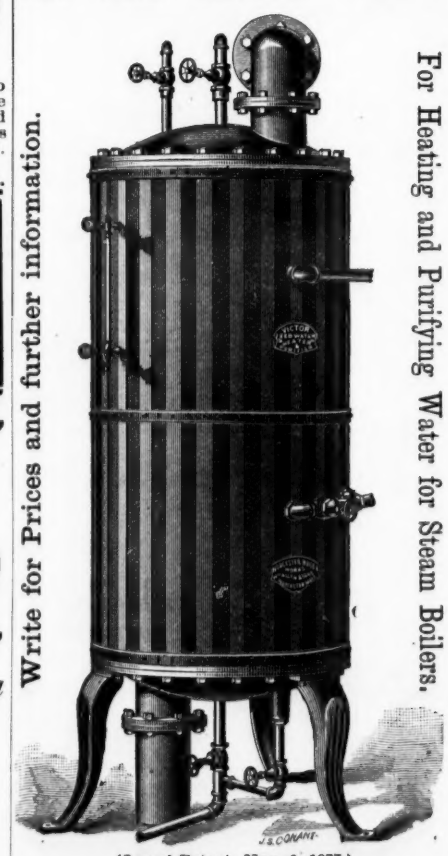

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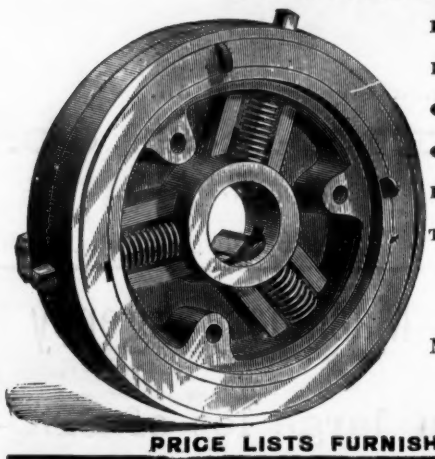

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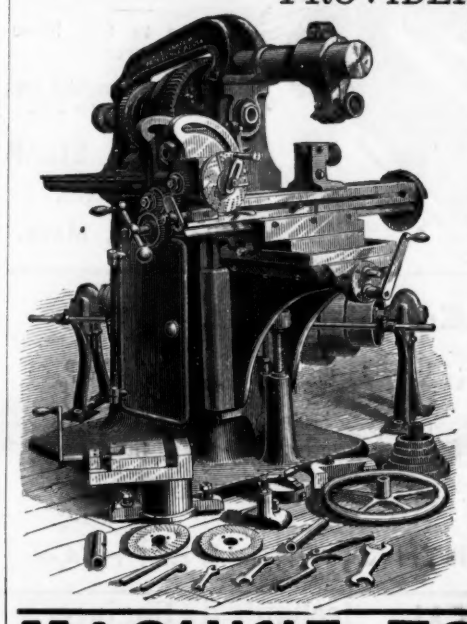

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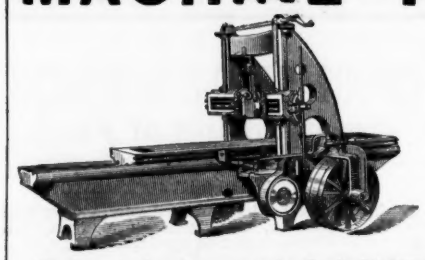

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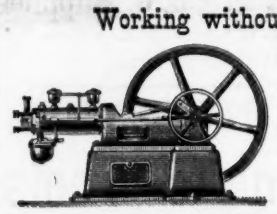

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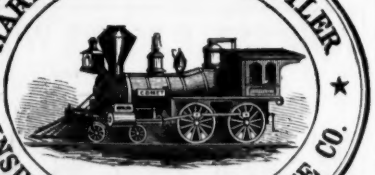

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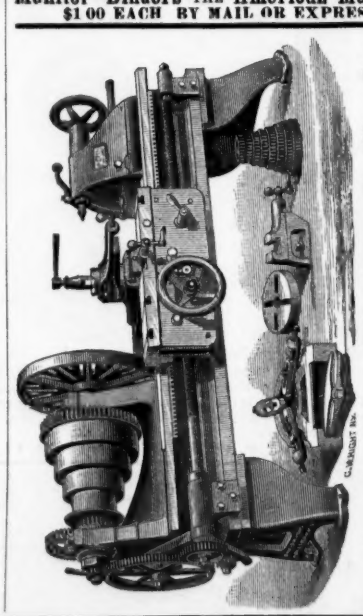

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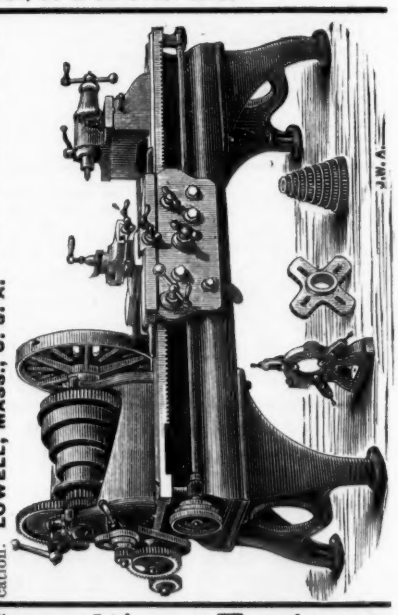

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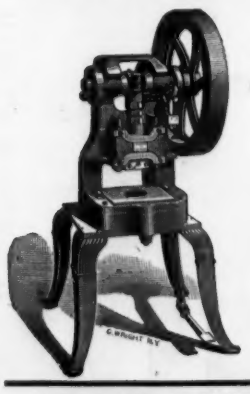

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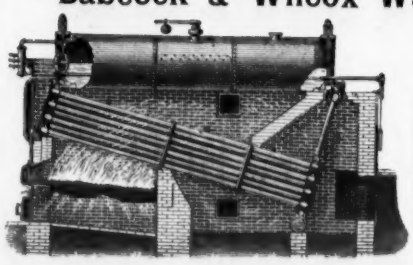

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